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See Page 34

NUARY

Hydro-Glider Skims the Waves at 70 Miles an Hour

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POPULAR SCIENCE MONTHLY

Most Wonderfully Illustrated Magazine in the World

JANUARY, 1924; Vol. 104, No. 1
25 cents a Copy; $2.50 a Year

Published in New York City at
225 West Thirty-ninth Street

IN 1843 an official of the United States Patent Office resigned "because everything possible had been invented." He added that in his judgment it was only a matter of months until the Patent Office would be forced to close through lack of business.

And that was before American patents had been granted on the sewing machine, typewriter, electric locomotive, air brake, wireless telegraphy, internal combustion engine, airplane, cash register, incandescent lamp, motion-picture machine, and more than a million and a half other inventions that we now consider commonplace!

* *

YOU, no doubt, will agree that the Patent Office employee was shortsighted. But how about yourself? Have you ever looked into the future? Have you ever pictured yourself making an important contribution to the comfort and happiness of mankind by developing an invention? You may say you have no talent for invention. But is that really the truth?

* *

WHEN you do something about the house—when you devise a temporary way to stop the windows from rattling, or stop a leak in the plumbing—you are doing something inventive. Does it ever occur to you that what you are doing might be something that thousands of others would do if they knew about it? Does it ever occur to you that your idea might be worth money to you?

* *

YOU may say that the thing you have worked out in your own mind is trivial. Perhaps it is, but it is from trivial things that valuable inventions often spring. More than 50 years ago a man got the idea that a rubber at the end of a pencil might be a convenience. This may have been a trivial thought, but it netted him a fortune. The safety razor, the fountain pen, the metal cap for bottles are simple things; yet they have brought wealth to their inventors and manufacturers.

* *

THOUSANDS of devices of this sort still remain to be invented. Successful inventors have reduced the business of invention to a formula. Look about you until you observe some human need, they say; then go about satisfying that need. That short sentence tells the story of every invention.

Probably you need not look beyond yourself to recognize some human need that invention might satisfy. Is there something that would add to your own comfort and happiness? Invent it. If it is useful to you, it will be useful to others. Moreover, the rewards of invention are paid not only in money, but in the priceless satisfaction that results from successful creative work.

In Next Month's Issue

Astronomy from the Cellar—The fascinating story of a New England governor's underground observatory.

Our Senses—Gateways of Knowledge—A usable article in Dr. James J. Walsh's psychological series. "The Story of the Mind" tells how you can use your mind to get greater happiness, better health, and bigger success out of life.

Your Radio Troubles — Jack Binns, America's most popular writer on radio, will tell where they come from and how to avoid them.

Frozen Radiators—Balky Engines—An expert tells how to prevent annoying and costly automobile troubles in winter.

Secrets of the Mighty Atom—The most remarkable photographs ever published, showing the nature and movements of atoms, reproduced through the courtesy of Sir Ernest Rutherford, great British physicist.

And 200 other fascinating articles and pictures

POPULAR SCIENCE MONTHLY

Issued monthly. *Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, $2.50; foreign countries, $3.*

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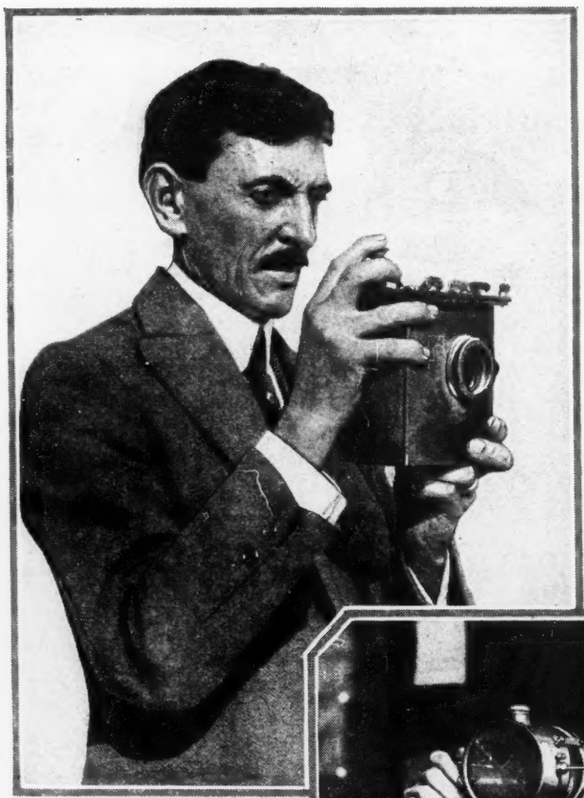
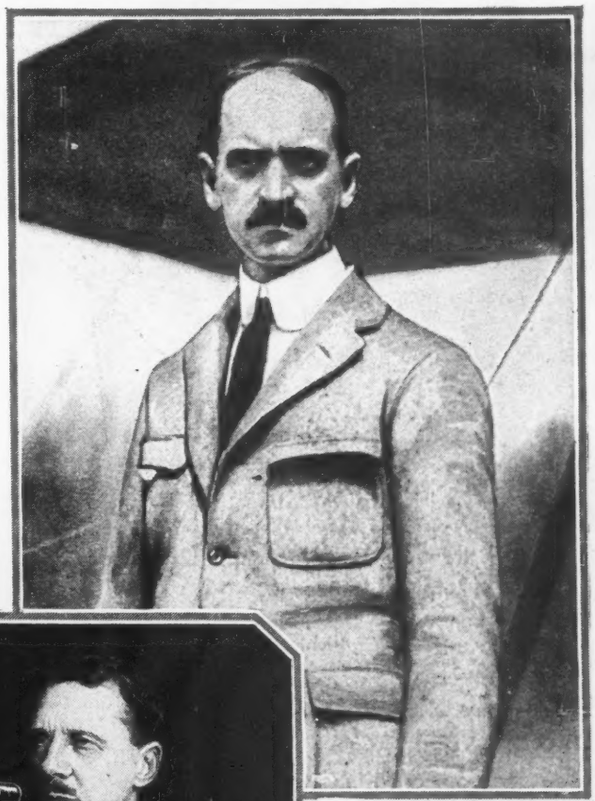
O. B. Capen, *Secretary and Treasurer*

Men of the Hour in Science



DR. PAUL BARTSCH, head of the Division of Mollusks of the Smithsonian Institute, Washington, D. C., demonstrating the compact underwater motion - picture camera which he has invented to photograph creatures of the sea. Diving into the clear waters about the Bahama Islands, he recently obtained remarkable movies of many varieties of strange fishes in their native haunts



© Keystone

GLENN H. CURTISS, pioneer of American aviation, is the first to "hop off" from the surface of the water in a motorless glider. In recent tests in Manhasset Bay, off Port Washington, L. I., an extremely light hydroplane glider designed by him rose from the waves, after being towed some distance by motorboat

DR. S. C. LIND, new Chief Chemist of the United States Bureau of Mines, is one of the foremost radium experts in the United States. He is shown above with his own invention, an improved electroscope designed for measuring radium. When the instrument is placed in the field of radium emanations, the time required to discharge the electroscope determines the percentage of radium in the sample

DR. W. W. CAMPBELL (left), director of the Lick Observatory and president of the University of California, in a recent statement declared that certain areas of Mars, as detected through the telescope, change in color with the seasons, indicating that there might be vegetable life on Mars

DR. ROBERT A. MILLIKAN, of the California Institute of Technology (right), has been awarded the Edison Medal for meritorious achievement in electrical research by the American Institute of Electrical Engineers. In presenting the award, Dr. F. B. Jewett, president of the institute, declared that "in the last two decades Millikan has done more to influence young men toward clear thinking in scientific research than any other man in America."

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Lao Tzu

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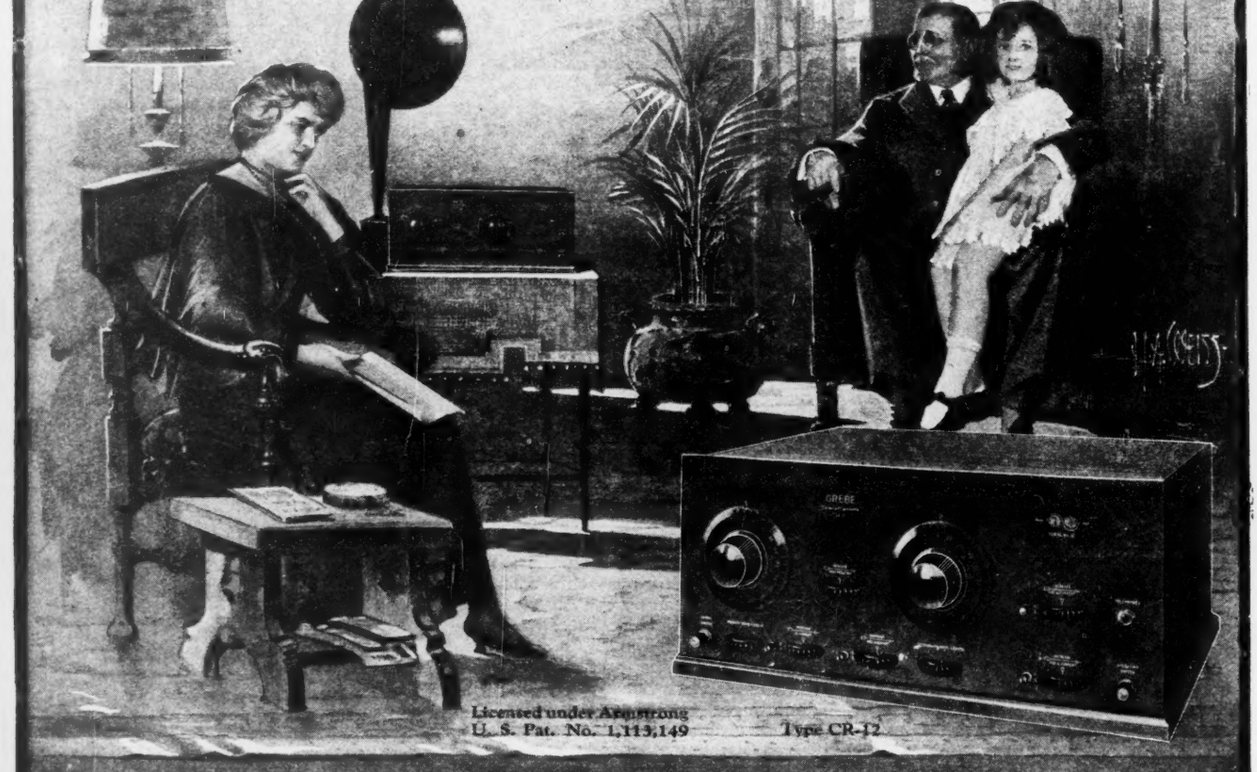

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POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
January, 1924

Take the Brakes off Your Brain!

First Article of a Vitally Useful Psychological Series—

The Story of the Mind

By James J. Walsh, M.D., Ph.D.
Famous American Surgeon and Psychologist

A FEW days ago a small fire occurred in a house near mine. I happened to be looking out of my window when a man rushed down the street to turn in an alarm at the corner box. In an almost unbelievably short time—not more than two or three minutes—a fire engine pulled up before the house. A few minutes later the blaze had been extinguished and the engine had departed.

A Wonderful Alarm System

This was no extraordinary occurrence; simply a commonplace incident of present-day city life. Still, I could not but wonder at the swift passage of events that followed the ringing of the alarm. Here was a marvelous combination of human ingenuity and discipline. Automatically the touch of a finger on a switch within the alarm box had summoned a roaring engine to the exact location of the fire. Then, with perfect teamwork and precision, their trained firemen had gone about the work of putting out the blaze.

And yet, as a psychologist, I had little reason to marvel at what I saw. For the complex electrical fire-alarm system and the perfect discipline of the firemen represented only an imperfect imitation of the wonderfully sensitive alarm system operating in every normal human body.

At the heart of this system is a central control station—the brain. Leading from it to every "corner box" of the body is an elaborate network of wires—our nerves. And finally, responding to every interchange of messages or alarms, that flash along the nerves to and from the brain are our muscles, performing for us the movements necessary to protect and support our lives.

On the degree of perfection with which this complicated nerve system functions, and on the precision and discipline of our muscles in responding to every signal flashed to the brain, depends largely our success in meeting the tasks or emergencies that every-day life presents. To learn the secret of this wonderful network of living nerves and muscles, to discover its weaknesses, repair its faults, and to make it respond more surely to our common needs—this is the part of psychology.

At one of the World Series baseball games in New York last fall I witnessed an incident that illustrated in a vivid way the workings of the human alarm system. One of the Yankee batsmen hit a fly ball over first base, well out in right field. It was beyond the reach of the first baseman and the right fielder—apparently a safe hit. And yet the fly was caught by Frisch, second-baseman of the Giants, even though, when the ball was hit, he was stationed farther away from its ultimate landing place than any other player.

The reason Frisch caught the ball was this: Almost at the instant the batsman struck the ball, Frisch had started running in the direction it was traveling. In fact, to most people in the stands his first movement seemed to coincide with the crack of bat on ball.

Messages Flashed to the Brain

Yet the two events really were not simultaneous. Between the instant the bat touched the ball and the instant that Frisch started to run, there was an infinitesimal pause. And during that pause, a highly complicated series of actions and reactions had taken place in his body—comparable to the transmission of electric signals and the resultant appearance of the fire engines, but infinitely more complex and infinitely more certain.

The crack of the bat stirred into action delicate nerve centers controlling the man's vision and his hearing. From these nerve centers, sensitive nerves carried a report of that event to certain brain cells. These, accepting the message transmitted from the eyes and ears, retransmitted it along another line of nerves to the muscles that carried him in the direction of the ball. And not until these muscles received the relayed message did he move.

That may seem like a long and complicated explanation of a process that took place in a space of time so short as to be virtually incalculable; but it is typical of the working of the wonderful human nervous system and its guiding power, the brain. Every time we perform a conscious action, there is just such an interchange of messages between our nerve centers, our brain and our muscles.

If you accidentally touch the glowing end of a cigar, you quickly draw your hand away. This may seem to you

This chimpanzee represents one of the very highest orders of animal intelligence; yet his capabilities end where those of the baby begin. Animal instincts rule the life of the chimpanzee. He has reached his limit of progress. But in the baby the mind is master. The baby can reason; and there is no limit to his progress and the heights he can achieve

to be an instinctive action—one performed more or less automatically by your muscles without the direction of your brain. But it is not. You pull your hand away because your brain, sending the message of pain from your finger tips, directs your muscles to remove it from the danger area, just as the brain of the baseball player directed his muscles to carry him toward the flying ball.

Yet while processes of this sort may seem complicated, really they are elementary when compared with other and more amazing processes by which our brains and nerve systems serve our needs. Even the lower animals possess nervous organizations that guide them in avoiding danger or pain and enable them to perform actions necessary to support life.

The Chimpanzee

Consider the chimpanzee shown with the child on the preceding page. The chimpanzee has a high order of animal intelligence; it can do some things that are as yet beyond the capabilities of the child. But the animal can't reason and in a few months the child will outstrip it mentally. The chimpanzee lives by its animal instincts. It never can progress. But there is no limit to the progress of the child.

Man Reasons

The one important and essential difference that distinguishes man from the lower animals is that man possesses a mind. He reasons. His life is ruled not by every passing impulse that flashes across the transmission lines of his nerves. Rather, his mind is master. His brain, the central station, rules. It is the guiding power of his nervous system, and consequently of his body and its functions.

Lock a cat in a box covered by a lid that will spring open at the touch of a lever, and the cat will remain a prisoner. It will struggle madly, clawing at the sides of the box, hurling itself about as a protest against its confinement; but all its efforts will fail to bring release unless, of course, it should touch accidentally the lever operating the lid.

But lock a man in a similar box and observe how different are his actions. He will not struggle, he will not hurry. He will consider his situation calmly until he discovers that by moving the lever he may cause the lid to rise and so gain his freedom.

In every normal, healthy man the brain is ruler. It exercises its control over his muscles through certain groups of brain cells called motor centers, each controlling its own set of muscles. Long ago science by experiments with animals, discovered the specific locations of the motor centers controlling the movements of the legs, arms, face, fingers, in fact, every part of the body.

Psychology, the scientific study of the mind, has revealed one extremely important fact about these motor centers that holds the key to success or failure. It is this:

Impulse Needed

Your brain, though it is the ruler of your body, has not the power of itself to initiate thought; nor can it, of itself, direct your muscles to perform any definite action. It must receive, first, a suggestion or impulse from without.

A ring of your doorbell, the entrance of another person into the room where you are reading, or some other interruption, may cause you to put down this magazine—a thing which, if you are interested, you probably have no intention of doing.

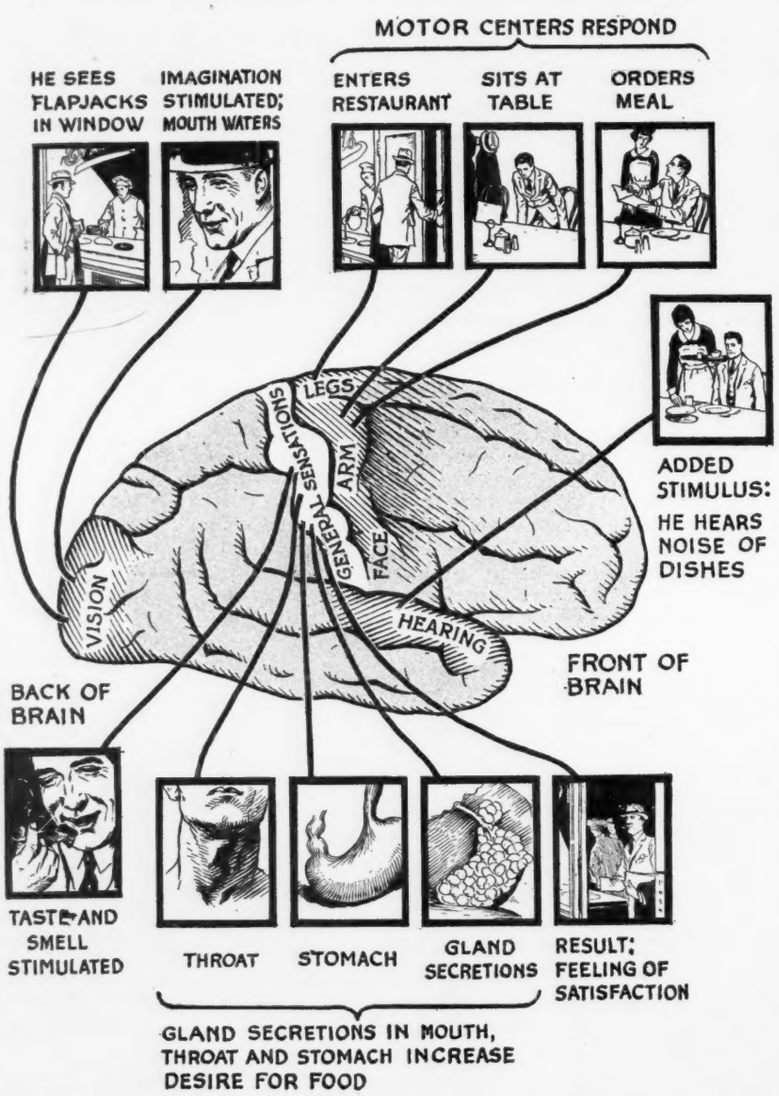
Or, take the case of Frisch, the Giants' second-baseman. His motor centers did not direct his muscles to move toward the fly ball until *after* his brain had perceived that movement was necessary if he was to intercept the ball.

Why You Act

Although you may be awake, you will not rise from your bed in the morning until the sunlight or the sight of your clock informs you that the time has come for you to be about your duties. On your way to take the street car to your office or shop you will not hurry unless you learn in some way that hurry is necessary because you have left your home at a later time than usual. Also, you probably would not be going to work at all had your brain not learned, either from your own experience in the past or by information you have received repeatedly from

(*Continued on page 130*)

How the Brain Controls the Body



HERE is a picture story of how the brain, receiving stimuli from without, transmits the sensation of hunger to the body and moves the muscles to responsive action. The man in the pictures first sees flapjacks cooking in the window. Through the visual center of the brain his imagination is stimulated. He imagines himself in the restaurant eating flapjacks, which causes stimulation of the senses of taste and smell and of certain glands of throat and stomach. Through their secretions, these glands bring increased desire for food—the mouth-watering sensation. Noises in the restaurant add still another stimulus. All these sense messages are transmitted through the motor centers to the muscles, which act to satisfy the hunger

Army Airship Rescues Fallen Aviator from the Sea

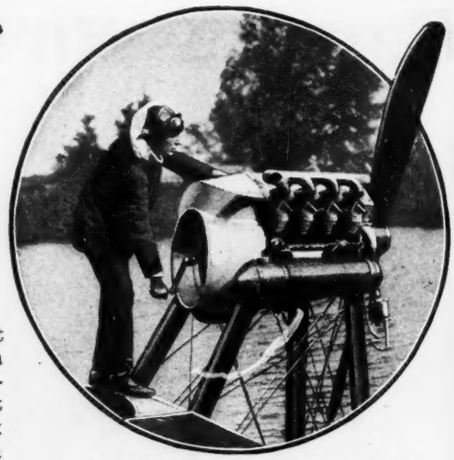
THE airship has proved itself to be an effective life saver at sea. The illustration, from an actual photograph, shows the spectacular rescue of a fallen aviator by the U. S. A. airship D-3 recently off Cape Hatteras.

The remarkable feat was accomplished by lowering the airship to within 15 feet of the water. The ship's speed then was killed by heading it into the wind and idling the motors. With a rope ladder trailing in the water, the ship approached the wrecked airplane slowly until the swimming aviator could grasp the end of the ladder and climb to safety. To allow for the weight of the extra passenger, ballast was thrown out, and the D-3 rose again.

In performing the rescue the D-3 was commanded by Captain William O. Butler, 19th Airship Company, Langley Field, Va. The rescued aviator was Staff Sergeant Charles V. Williams of the same company.

Seventy Miles an Hour in a Hydro-Glider

New Air-Propelled Boat Skims Waves at Express-Train Speed



An airplane engine and propeller, mounted high on braced struts, drive the new speed craft

SEVENTY miles an hour in three inches of water is the astounding performance claimed for a revolutionary new type of air-propelled glider-boat developed by F. W. Davies, of Dudley, England.

This feat is the more impressive because, unlike most craft that threaten the world's speed record, the Davies hydro-glider conquers water not by sheer, costly massing of compact power, but essentially by minimizing friction. Nautical super-speed, hitherto exclusively a sport of open-handed millionaires, therefore is brought within the reach of every water lover.

Commuters May Use It

But its importance as a new plaything for sportsmen is overshadowed by its significance as a promising attack on the problem of commuting to and from large cities. A New-Yorker with one of these wave-skimming boats could enjoy the pleasures and economies of country residence, commuting daily down Long Island Sound or the Hudson. Every inland waterway in the country, such as the Great Lakes, the Mississippi and Missouri rivers, would become a quick and open road to points now sparsely settled because of the slow speeds at which most river and lake craft travel.

An airplane propeller and engine drive the hydro-glider. Thus the enormous friction exerted by water upon high-speed propeller blades is avoided. Moreover, such propulsion helps achieve the shallow-water operation that is imperative for safe navigation on many lake and river stretches.

The Rudder

Even the main rudder, a high, finlike projection, operates by deflecting air instead of water. Two small water rudders are located on the transom for maneuvering, but they rise above the surface as soon as the craft has picked up speed.

The chief factor in effecting the craft's amazingly shallow draft is the wide, somewhat flat bottom. The weight is distributed over a large water area, sharply limiting the displacement depth. This construction not only greatly reduces the danger of wreck and injury by lifting the craft's bottom above the reach of most underwater dangers, but further lessens the potential friction. For at high speeds the hydro-glider skips from wave to wave instead of pushing through the water. The lifting power of the water is utilized to the uttermost, while the resistant strength of it is avoided to a marked degree. Thus the new craft adapts the most efficient principles of the famous seasleds, which some years ago upset many traditions of nautical construction.

Even wind friction is reduced by the scientific design of the Davies craft. Only the cockpit portion is raised. The hull is low and flat to prevent resistance to the lusty breeze encountered at high speeds. The forward end of the cockpit is rounded for the same reason.

The hull is oblong in shape, with a tapering tail upon which is the main rudder, operating directly in the air stream from the propeller.

Strength of Construction

The airplane engine and the air screw are mounted high on struts braced by diagonal wires. The cockpit, forward of the engine, seats six persons. The main walls of the hull are braced at close intervals with timbers, while the longitudinal stringers and the keel are fastened by stout metal gusset plates riveted together. The bottom, which bears a great strain, consists of two skins laid at 45 degrees to each other. A double layer of chemically treated and copper-fastened fabric lies between these skins. Moreover, the bottom is constructed so that a damaged plank can be replaced at slight cost.

Perfect control of the craft is said to be possible at all speeds. At half throttle it is said to glide 40 miles an hour. Because of the reduction of friction its fuel cost is low.

The world's speed record for power boats, 81.5 miles an hour, is held by *Miss America II*, Gar Wood's motorized hurricane.

Yet the Davies hydro-glider, an embodiment of striking departures in design, almost equalled this record in its first trials. It demonstrated thus the soundness of principles which may set a new mark for speed boats to shoot at.

The hydro-glider piloted by its inventor, F. W. Davies, of Dudley, England, during recent tests in which the novel craft skipped over the waves at a speed of 70 miles an hour

A Busy Man's Hobby—The Stars

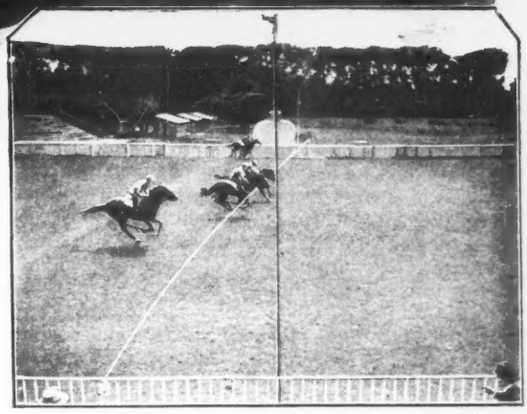
DID you ever consider the significance of the fact that the small end of an astronomical telescope always points toward the earth, while the large end points to the heavens?

James Hartness, former governor of Vermont, noted engineer, inventor, and business man, is one man who has.

"Whenever my worries get too much for me, I find solace in my telescope," he says in a notable interview in next month's POPULAR SCIENCE MONTHLY. "Then the seeming importance of the little affairs of this world pales to insignificance in comparison with the vast worlds that lie beyond us."

Don't miss this fascinating story of Mr. Hartness' hobby—a remarkable underground observatory where he embarks on wonderful journeys into the skies.

Cameras Pick Race-Track Winners



A close finish, automatically photographed from the judges' box. The black vertical line across the center of the photograph, produced by a fine thread in front of the camera lens, is in line with the finish post. It's easy by this method for the judges to pick the winning horse

By Truman Stevens

A SWIFT, short flash—often only a blur of straining heads—upon the retina of a human eye decides the winner of most horse races. Thousands and occasionally millions of dollars poise upon that flash. Hundreds of decisions have been questioned, many no doubt justly, for even a judge's eyes are humanly fallible.

But lately on a Belgian track a specially devised camera, ingeniously connected with a finish tape, has been the court of last resort. This invention, recently improved by a Frenchman, now awards contested places at the famous Maisons-Lafitte track.

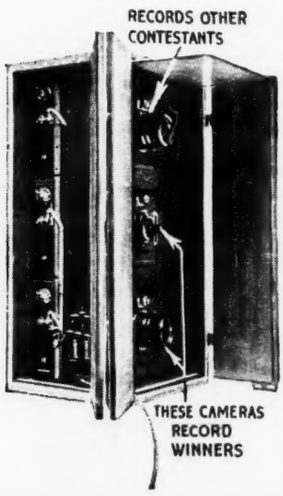
A green cotton thread that operates the camera shutters when touched by the winning horse, is stretched across the track at the height of a horse's breast. It is just enough in front of the finish line so that the photograph registers the exact moment when the winner's nose appears in line with the winning post.

Two posts, from 23 to 26 feet high, one atop the judges' box, the other on the opposite side of the track, are equipped each with three convergent cameras. These are disposed so that a fine vertical line just before the focal center of the glass screen of each camera is in line with the winning post and the judges' view. Four of these six cameras—two on each post—are operated simultaneously when the winner's breast touches the finish thread. Two of the four—one on each post—have one focus, and the other two have another focus, giving four varying pictures. Thus a good photograph of every horse and of every inch of the finish line is assured. A fine line indicates on each photograph the location of the finish line.

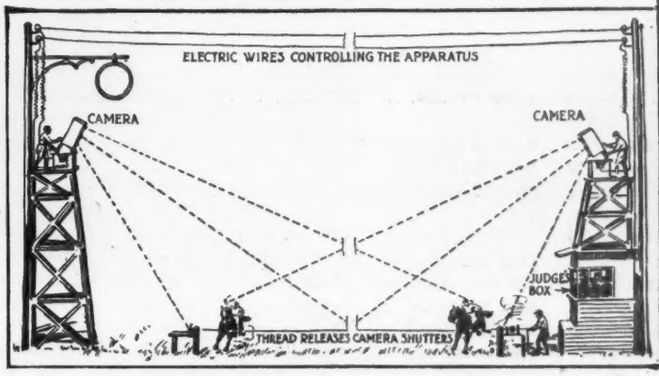
The remaining cameras—one on each post—are released simultaneously by an operator. These two are intended to photograph a group containing one or more placed horses when such a group is separated from the winning horse by some distance.

The thread that actuates the automatic cameras will withstand a steady tension of nearly 20 pounds, but will break at a slight shock. It ends at each post in an electric contact formed of two flexible plates barely separated. Contact between the winner's breast and the thread causes an increased tension resulting in an instantaneous contact between the plates. The resultant current, through a magnet, releases the shutters of all four cameras.

Three minutes after the race is won, the pictures establishing the winners are developed. If the judges have no doubt of the result, they announce the decision as soon as the race is over. Otherwise the word "Photograph" is posted and the onlookers await the verdict of the mechanical judges.



The diagram below shows how triple cameras are focused on the finish line on each side of the course at the winning post. Note how the cameras are arranged to focus on every horse. At the left is one of the triple cameras, and at the right, the automatic apparatus that opens the camera shutters when the winning horse touches a thread stretched across the finish line



Air Flivvers for Everybody

Midget Planes to Sell for $150 and to Fly on a Thimbleful of Gasoline

By Donald Harris

A LITTLE more than 20 years ago, people rushed to their front doors to watch an automobile go by. Ten years ago an airplane could draw the eyes of a countryside.

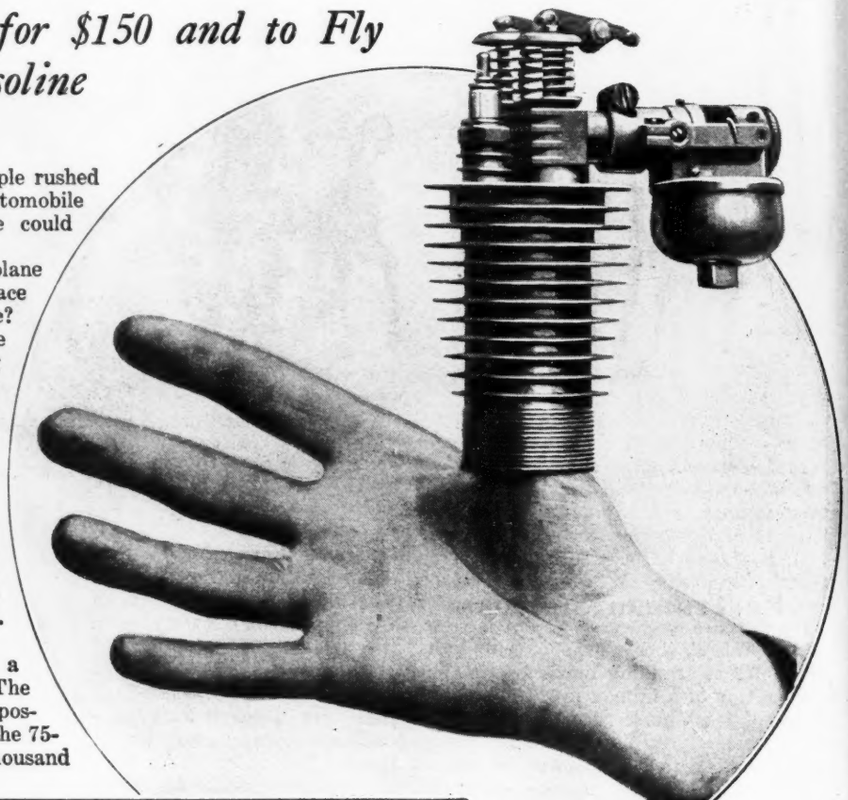
How long must we wait before the airplane becomes like the automobile, a commonplace of transportation, a family convenience? How soon before the housewife, who once lifted the kitchen window at the droning roar of a plane, looks down upon that kitchen window from where the birds are? In a few years, at most.

In the recent international motor glider contest at Lympne, England, two pilots each flew 87 miles on a gallon of gasoline. Another drove his tiny sky sparrow at a speed of 75 miles an hour. These amazing aerial midgets were restricted to engines of not more than 7½ horsepower and to a width of 10 feet from wing tip to wing tip. Their average cost was only $1000.

Such sensational achievements are in a comparatively virgin field of aviation. The "flying flivver" is an infant, with an infant's possibilities. The 87-mile gasoline record and the 75-mile speed record are pioneering feats. One thousand dollars will not long remain the minimum cost of such machines. Lawrence Sperry, inventor of the tiny "messenger" plane, confidently predicts that the $150 plane is only a few years away. Quantity production of small engines is now the only thing standing in the way of such cheap machines. These engines could be built in large numbers for $50 each, according to Henry Ford.

But, ignoring everything except achieved facts, we find the implications of such facts tremendous and astounding.

One of these "air babies" could fly from New York to Chicago, 908 miles by rail, in 12 hours on 10½ gallons of gasoline. The fastest train takes 20 hours. At prevailing fares and gasoline prices, the aerial trip would cost nearly $30 less than the rail trip. Railroad fares the country over average 3.6 cents a mile. Investment and upkeep aside, the air flivver fare would be .3 of a cent a mile.



The above photograph of the world's smallest gasoline engine gives an idea of what we may expect in the development of inexpensive power plants for future air flivvers. This engine, displayed recently in London, is said to run 250 miles on a gallon of gasoline and to drive a motorcycle at an average speed of 25 miles an hour. In the recent air-flivver contest in England, 7½-horsepower airplane engines of the motorcycle type drove baby planes 87 miles on a gallon of gasoline at a speed of 75 miles an hour

A Vickers "air baby," of less than 10-feet wing spread, piloted by Captain Cockerell, in test flight at Lympne, England

A Short Hop between Cities

To one of these Tom Thumb planes, Chicago and Omaha would be 6½ hours apart. Chicago and St. Paul, or New York and Pittsburgh, would be six hours apart. Eight hours would separate New York and Akron. A Senator could leave Washington, D. C., at 10 A.M. and keep a speaking engagement in Chicago at 8.30 in the evening. Flying 10 hours a day, one of these planes easily could reach San Francisco from Chicago in three days. A 13-hour flight would put a Seattle business man at a conference in San Francisco.

All these figures are based on railroad mileage. And a plane flies as does the crow.

The commuting possibilities of the "air flivver" beggar the splendid achievements of the automobile and the electric train. Thousands of commuters spend an hour riding to and from their work twice daily. The expenditure of the same amount of time with an aerial flivver would bring cheap land, country rents, and country life within reach of millions in the overgrown cities. At the close of the day the New Yorker could take an elevator to the roof of his office building and fly to dinner with his family in the quiet of New Hampshire's White Mountains, or in the Adirondacks.

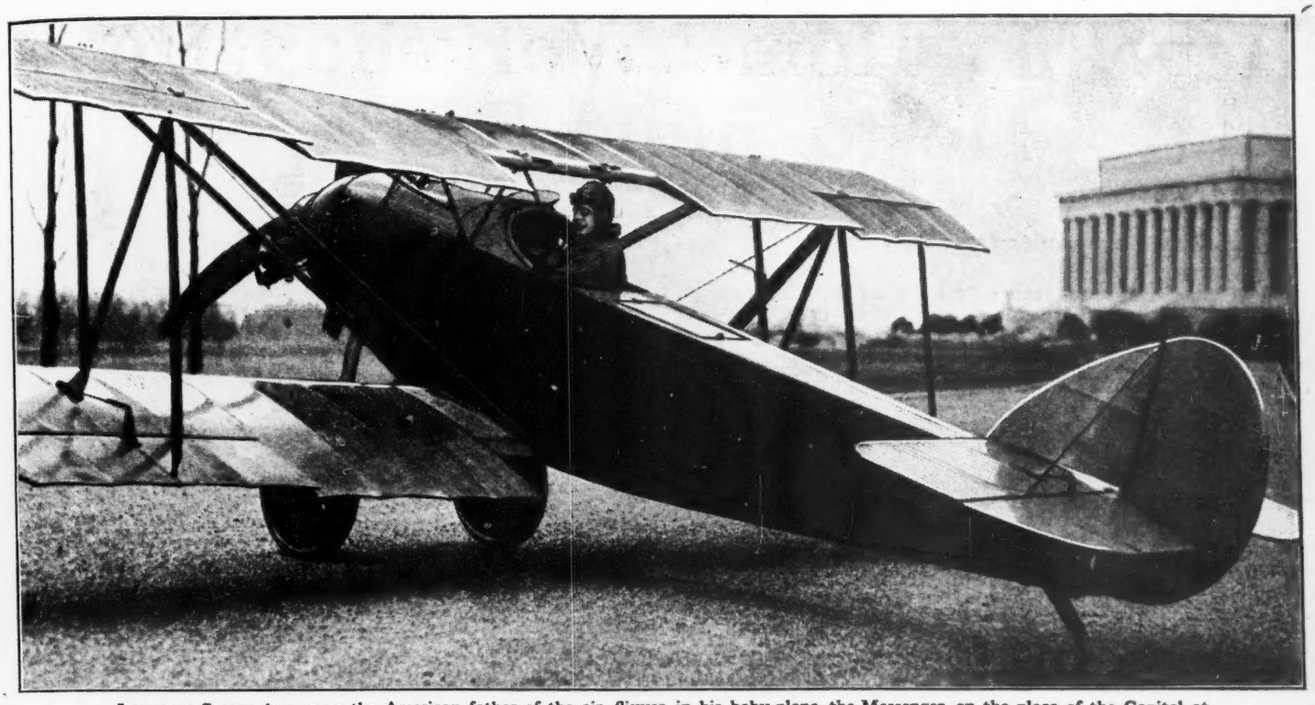
True, there are now no adequate facilities for landing or for the housing of planes. But how old are service stations and garages? Protected skyscraper tops would offer ideal landing areas. Beacon routes for night flying, proved a success by the recent night air-mail tests, will interlace across the continent as rapidly as the need for them widens, as surely as good roads followed the automobile.

Aerial vacationing and week-ending on a grand scale are as obviously impending facts—facts that we shall accept soon as calmly as we now accept radio.

Week-Ends in Remote Places

Small, speedy airplanes would enable Chicago business men to enjoy their week-ends in the Canadian lake country and their summer vacations in the Rockies. The miles that separate inland lovers of the sea from ocean beaches would shrink. Yellowstone would be eight hours from the farmers of middle Kansas, while New York winters would be 12 hours from Florida's beaches.

In fact, the "air flivver" would make every foot of America accessible. Remote and hitherto inaccessible fastnesses of



Lawrence Sperry, known as the American father of the air flivver, in his baby plane, the Messenger, on the plaza of the Capitol at Washington, D. C. This plane has a wing spread of only 20 feet. Sperry predicts that the day of the $150 airplane is not far distant

nature could be invaded with ease. Rich men may buy mountain tops upon which to build their estates.

It may not be too much to predict that far-seeing real estate operators will have the opportunity to pile up tremendous fortunes, as did the original Astors, by buying for a song isolated plots of land within airplane commuting distance of large centers. Certain it is that as population increases so will the demand for property in what are now remote sections. Moreover, the city's advantages in culture, entertainment, shopping facilities, and variety would, by means of the small, speedy plane, be brought as close to the farmer and the long-distance commuter as was the grocery store before gasoline outstripped hoofs. The country dweller's family physician could be one of the city's best. Neither drifted snows nor bad roads would stop a plane. In the air there are no grade crossings, blind corners, speed limits, nor traffic congestion.

An airplane is a simpler mechanism than an automobile of corresponding quality. Fewer mechanical problems have confronted aeronautical designers.

Cost to Be Low

As a result, modern airplanes are mechanically almost perfect. Hence the cost of planes and their upkeep—after large-scale production and wide use have done for them what they did for automobile prices—will be less than that of automobiles. The flights at Lympne, England, demonstrated strikingly their far lower fuel demands.

These facts, in the light of the past year's astonishing strides toward ultra-practical aviation, add significance to Henry Ford's recent interest in small airplane development. A year ago he announced that he would not make planes until they had become commercially practical on a generous scale.

Competing in the motor glider contest at Lympne, England, this midget Wren machine flew 87 miles on a gallon of gasoline. The "air baby" is shown passing through a seven-foot gate in a qualification test. The upper picture shows the Wren's 3½-horsepower engine being refilled

Airplane driving—high speed and trick flying aside—is not a difficult art. It cannot be learned as easily as automobile driving, but, once learned, it is easier. With rare exceptions, the men who have met death in aviation were taking dangerous and unnecessary chances, just as the goggled heroes of the automobile race-track have taken chances and paid. What the race drivers of the track did to make your car safe, the daredevils of the air have done to make flying safe for you.

The Sensible Flier Is Safe

Only in one case in a hundred is an aerial accident today a consequence of mechanical defect. And even in such rare cases—though the engine stops or the propeller breaks—a plane is in no particular danger. Side-slipping and careful gliding in practically every case will effect a safe landing. Even if a tree or building is struck in landing, a driver is not likely to be hurt; for landing speeds, particularly those of small planes, need not be great enough for bodily injury. In short, a sensible flyer is safer than a sensible motorist, because the wide roads of the air minimize the danger from fools.

The automobile altered the course of civilization profoundly and beyond measure. It left no household and no life untouched. It is conceivable that the airplane will be just as revolutionary; and the air flivver is today's signpost in our swift progress toward that era.

How My Home Workshop Helps Me to Build Stories

By Arthur Stringer

Noted American fiction writer, author of "The Prairie Wife" and many other novels and short stories

IT IS one of the paradoxes of mental activity that this brain of ours rests most when it is most earnestly at work. Expenditure, in this case, is the true source of economy.

If you are a child, you play a game. If you are a grown-up, you have a hobby. And if you are a normal man it's ten to one you will take your avocation much more seriously than you do your vocation.

Now this word "hobby," if etymology and memory serve me aright, comes from the "hobby-horse" of the old morris dances, the painted wooden imitation of a horse which, instead of carrying the actor on its back, was actually carried about by that actor. So a man is always most squarely on his feet when he rides a hobby. And the hobby which I have found most stabilizing and stimulating, in my own case, is a home workshop.

Why I Prefer the Shop

It was not ever thus, I'm willing to confess, for I've tried my restless hand at many things. When a friend asked me why I gave up golf for a tool-littered imitation of a cabinetmaker's workshop, I said it was because I got more fun out of the workshop. When that same persistent friend wanted to know just why I got more fun out of my workshop, I had to put aside my jack-plane and sit down and fish for reasons.

I had to brush the sawdust off my overalls and tell him there were moods and moments when golf struck me as essentially childish, as so essentially childish that the vision of three or four dozen sclerotic old gentlemen solemnly knocking little white balls about 400 acres of landscape impressed me as slightly pathetic. There was something so self-defeatingly futile about them all.

Now a hobby, I find, has one subtle yet distinct advantage over a game. It is constructive, in so far as interest in it survives the moment of its practice. It is something done for a definite and perceptible end. And, being such, it is both self-justifying and self-perpetuating. It is not a self-deluding gesture toward youth, like the game of golf. It can forget to take itself seriously, for, unlike golf, it does not have to watch the lighting effects, the lighting effects that tint a mere game with a theatricalized importance just as a child's imagination tints its rag doll with the coloring of life.

A hobby, in this era of specialized labor, is also a wonderful preserver of balance. There is a fixed belief, of course, that authors have an uncommonly easy time of it, that their vocation is neither specialized labor nor any kind of labor. But after producing almost 30 volumes—good, bad, and indifferent—I'm grimly forced to the conclusion that this business of trying to amuse the world in its idle moments is much harder work than the world imagines. And the harder we work, the more we seem to need a hobby.

In my own case, after much experimenting, I found in a home workshop that nice balance between physical and mental effort that tended to keep reason on her throne and efficiency on her feet. Being already a builder of plots may have had something to do with it. But after carefully carpentering together a novel, I have found it unexpectedly restful to carpenter together a lawn bench. My subconscious impulse was still to build.

So I embarked on a recreational orgy of furniture making. Most of it, I'm afraid, was very bad furniture. Some of it was so bad that my discerning spouse committed it to the fireplace as promptly as the female infants of India were once committed to the Ganges. Some of it, after being duly put together, fell to pieces again like the One-Horse Shay.

Learning the Trade

But I am learning. My technique may not be perfect, but my ambitions are now restrained. I can at last make a highboy that stands on all four legs at once. I know how to stain and finish seven kinds of wood to convert it into true mahogany. I still occasionally cut myself with a drawknife and I still occasionally hammer my thumb. But I can at last console my Better Nature with the thought that I am doing something constructive at the same time that I can console my Better Half with the knowledge that I can make a Louis-Quinze cabinet not unfitted to a second-maid's bedroom.

But my immediate product is not the important thing. It's the fun I get out of making my wabbly old period pieces that counts. Some day they may no longer be spirited away by a shamefaced family. Some day they may even descend below the timber-line of the third floor. And in the meantime, at any rate, I have my two young sons who firmly believe in my ability with the chisel and saw, whatever my incapabilities with the pen may be.

That belief is founded on bows and arrows (after the three of us saw "Robin Hood") which can as easily break a second-story window as they can penetrate the painted canvas sides of passing delivery trucks; to say nothing of a windmill that sacrificially raced itself to pieces on the garage gable, and a canoe that unexpectedly turned out to be a submersible, and a box-kite that actually rose above the garden hedge during the well-known tornado of 1921.

Nor would it be just to a humble workman to omit a

It's the Fun that Counts

"A MAN is always most squarely on his feet when he rides a hobby," says Arthur Stringer. "A hobby, I find, has one subtle yet distinct advantage over a game—it is constructive. It is something done for a definite and perceptible end.

"In my own case, after much experimenting, I found in a home workshop that nice balance between physical and mental effort that tended to keep reason on her throne and efficiency on her feet.

"My immediate product is not the important thing. It's the fun I get out of making my wabbly old period pieces."

"After carefully carpentering together a novel, I have found it unexpectedly restful to carpenter together a lawn bench." Here is one of the sturdy lawn benches built by Arthur Stringer in his home workshop at Mountain Lakes, N. J.

ARTHUR STRINGER, noted American fiction writer, building furniture in his home workshop at Mountain Lakes, N. J. At the age of 49 he has written 25 novels and innumerable short stories, most of which, he says, have been evolved as by-products of other activities. His first year of newspaper work resulted in his first volume of short stories, "The Loom of Destiny," in 1898. Again, as editorial writer for the American Press Association, he completed his first real novel, "The Silver Poppy." An attempt to operate a fruit farm in western Ontario resulted in half a dozen books of adventure, including "The Gun Runner," in 1912. Another venture as a wheat grower in the Alberta foothills led to his three novels of Western life, "The Prairie Wife," 1915; "The Prairie Mother," 1920, and "The Prairie Child," 1922. He has traveled extensively and is recognized as an authority on criminology. He was born in London, Ontario, February 26, 1874

homemade Canadian toboggan that got so warped in the steaming, while giving a fit and proper *retroussé* tilt to its nose, that it developed into a sort of legless retriever and betrayed an unerring instinct to circle about on itself and return to the spot from which it first set out.

We have also a considerable number of birdhouses, constructed with meticulous care and, so far as we can judge, finished in unimpeachable good taste, which have remained singularly tenantless during the two years of their existence. The songsters of the air may never, in fact, house between those little waiting walls. But the blithe-spirited amateur in carpentry has been rewarded by the swarming thoughts that came to his empty head—and were later committed to paper—as he placidly and contentedly pieced those houses together.

Waters of the Jordan to Restore Palestine

As if Fulfilling Old Testament Prophecies, Engineers Harness for Electric Power the Sacred River where Jesus Was Baptized; "Rebuild Waste Places"

For the Lord shall comfort Zion: he will comfort all her waste places; and he will make her wilderness like Eden, and her desert like the garden of the Lord. . . .

And they shall build the old wastes, they shall raise up the former desolations, and they shall repair the waste cities, the desolations of many generations.

From the Biblical prophecies of Isaiah

Engineers are spreading a web of transmission lines from Dan to Beersheba and from the Mediterranean to the eastern edge of the Jordan valley, to serve a newly prosperous Palestine with electric light and power

By Raymond J. Brown

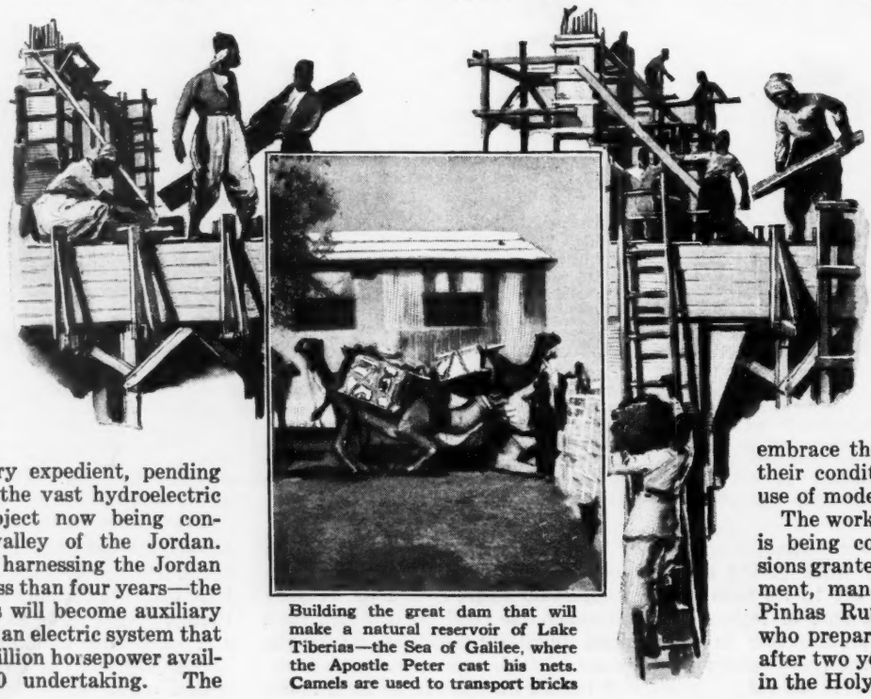
SEEMINGLY in striking accordance with the prophecies of the Old Testament, modern science has invaded the Holy Land, harnessing for electric power the sacred River Jordan where Christ was baptized. Engineers are impounding for irrigation of the arid valleys the waters of the Sea of Galilee where the Apostle Peter cast his nets, draining the fever-breeding swamp lands for agriculture, and spreading a web of transmission lines over Palestine from Dan to Beersheba and from the Mediterranean to the eastern edge of the Jordan valley.

Recently the first electric power station of the enterprise—an oil-burning plant developing 1000 kilowatts—was finished and put in operation at Jaffa (Joppa) on the Mediterranean shore. Similar plants are nearing completion at Haifa and in the holy city of Jerusalem. These three plants, soon to be connected, will supply electric current for municipal, industrial, agricultural, and domestic purposes. Incidentally they will provide the power to operate an electric railway from Jaffa to Jerusalem, the first step toward the ultimate electrification of all the Palestine transportation lines.

These oil-driven plants, however, will be merely a temporary expedient, pending the completion of the vast hydroelectric and irrigation project now being constructed in the valley of the Jordan. When the work of harnessing the Jordan is completed—in less than four years—the fuel-burning plants will become auxiliary emergency units in an electric system that will make half a million horsepower available—a $5,000,000 undertaking. The ultimate development will require about 20 times this expenditure. The Duke of Sutherland in debate before the British House of Lords not long ago called it "the most substantial contribution so far made by Judaism to the restoration of prosperity to Palestine."

The effect of the completion of the Jordan valley project is bound to be far reaching and revolutionary. Civilization has not advanced appreciably in Palestine since Biblical days. So far as the native population is concerned, no use has been made of the gifts of science, except in a few isolated farming operations. Ox-drawn wooden plows and primitive water wheels for irrigation are the machinery of agriculture. The inhabitants make their journeys on donkeys exactly as Joseph, Mary, and the infant Christ accomplished the flight into Egypt. Water for domestic purposes still is carried in hide sacks from streams and old wells. Oil lamps illuminate the homes. Long ago the forests disappeared from the country, and the rich soil was washed away from the high ground. Neglect has caused the once fertile valleys to become swampy and malarial.

But now, with electricity available, the swamps drained, and the valleys watered, the results of the neglect of centuries are likely to be repaired virtually overnight. Indeed, it is expected that the inhabitants of the Holy Land will make far wider proportionate use of the devices of modern invention—especially electrical—than do the people of America and Europe. For engineers say it will be possible to supply electricity throughout Palestine so cheaply that it can be used in every home for cooking and heating purposes, for which only wealthy persons are able to employ it in other countries. Further, the eager interest with which the native population greeted the recent introduction of a small quantity of modern agricultural and construction machinery seems to give evidence that the Jewish and Arab inhabitants both will embrace the opportunity to better their condition of life through the use of modern methods.



Building the great dam that will make a natural reservoir of Lake Tiberias—the Sea of Galilee, where the Apostle Peter cast his nets. Camels are used to transport bricks

The work of developing Palestine is being conducted under concessions granted by the British Government, mandatory of Palestine, to Pinhas Rutenberg, civil engineer, who prepared plans for the project after two years' study of conditions in the Holy Land. The recommen-

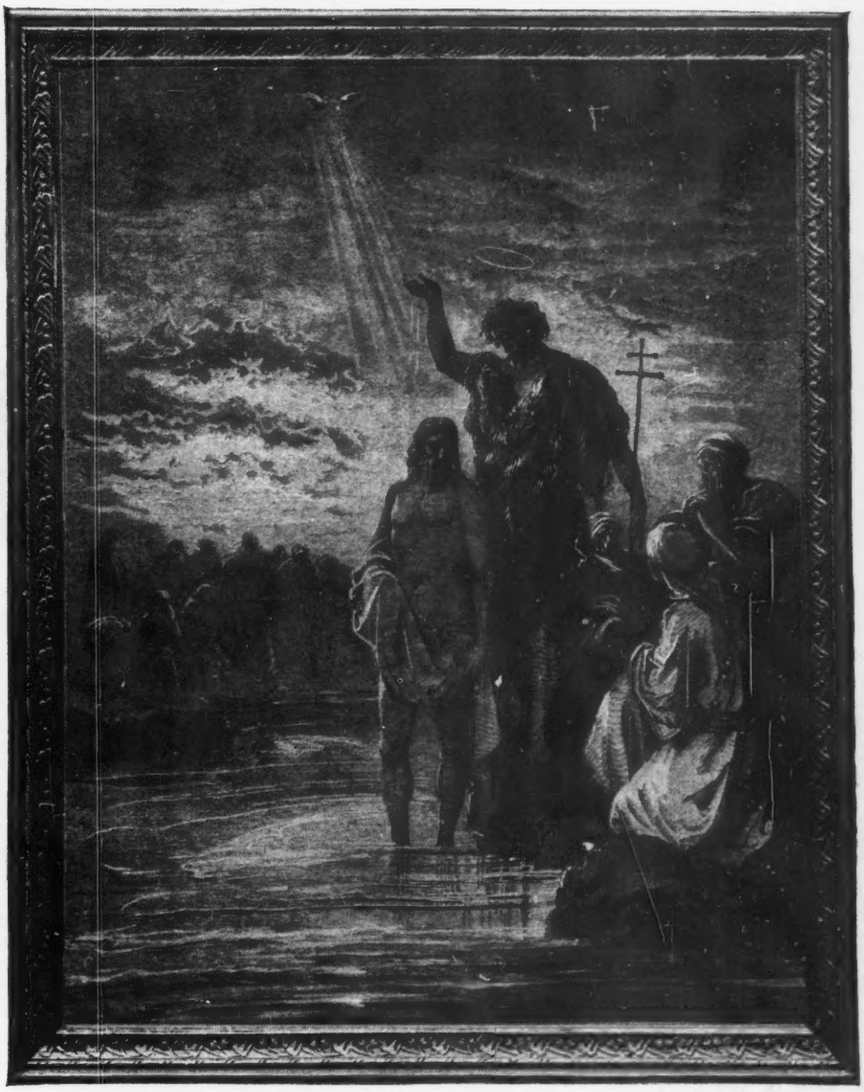
dations he made were agreeable to Zionist interests. When he sought the necessary concessions from the British Government, he obtained the financial assistance of Baron Edmond de Rothschild. These concessions were granted with certain restrictions regarding the capitalization of the company that would undertake the work, the rates to be charged for electrical energy, and the profits to be made by the company. Later the concessions were taken over under a deed of trust by the Palestine Development Council of New York City.

A Tremendous Project

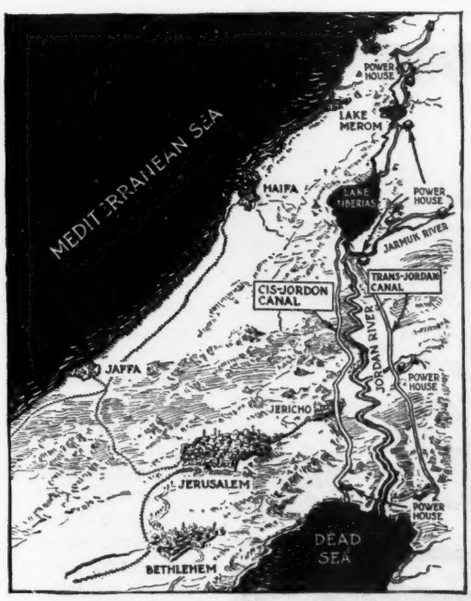
The enterprise is of such vast extent, covering practically the whole length of Palestine from north to south and the major portion of its width, that it was found impracticable to execute the entire project at once. It will be carried on in successive steps, keeping pace with the upbuilding of the country. Recently the efficiency of Jewish labor was tested under most unfavorable conditions, in parts of the Jordan where malaria is prevalent. The results are reported to have been most satisfactory in the quality of labor and in the endurance of the workmen.

Work is well advanced on the first big undertaking in the harnessing of the Jordan—the construction of a power plant situated about eight miles from the river's efflux from Lake Tiberias, or the Sea of Galilee. At this point a dam is being built similar to the Roosevelt Dam in Arizona. It will make of Lake Tiberias a great natural storage reservoir, containing almost 10,000,000,000 cubic feet of water available for irrigation and power. Canals will be dug on both sides of the Jordan, paralleling its course, to carry this water to 650,000 acres of dry lands.

Water required for electric power will be returned to its course in the Jordan after passing through the turbines. Transmission lines will carry the power generated to Haifa, Jaffa, and Jerusalem in a 66,000-volt system. Lake Tiberias provides a natural storage basin which, engineers say, is better than engineering could produce, making the total cost of the development low.



The baptism of Jesus by John the Baptist in the River Jordan—a reproduction from the famous engraving by Gustav Doré. The waters of the sacred river now are being impounded by a force of engineers to supply the Holy Land with electric light, heat, and power



Map of the River Jordan power and irrigation project, showing power plants and the canals to carry water from the Lake Tiberias reservoir

Conservation of the water resources is a necessity to the development of Palestine, since most of the annual rainfall of about 25 inches occurs during two months in winter.

In the nine miles of the course of its upper waters from Lake Merom to Lake Tiberias the Jordan falls 600 feet. This would seem to offer an ideal situation for power development, but, because of the present lack of means of communication and the more immediate necessity of irrigation and storage development, it was decided to erect the first power plant below Lake Tiberias. Between this point and the mouth of the Jordan in the Dead Sea, 68 miles away, there is a fall of 690 feet. The rate of flow of the Jordan at Lake Tiberias at present ranges from about 100 to 600 cubic feet a second.

When storage and regulation is completed and when some of the water above Lake Tiberias is used, the lower course of the Jordan, it is estimated, will have a regulated flow of about 300 cubic feet a second.

From these figures it can be seen that the Jordan is a small stream when compared with some of our American rivers, its average width being about 40 feet. However, its regulated flow, coupled with the considerable difference in level between its source and its mouth, makes it adequate to serve as the backbone of the power and irrigation development of Palestine, which is little more than one sixth the size of England. Great cliffs rising above the river banks at certain points along its course make it a Colorado River in miniature, and increase the engineering difficulties of the development.

Palestine to Have Cheap Electricity

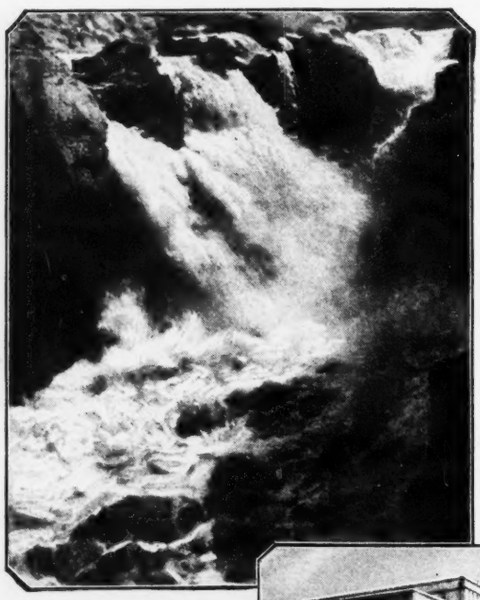
At present there is said to be an immediate market for an electrical energy output of 15,000,000 kilowatt hours in domestic and industrial service. The low development cost, permitting service at an unusually low rate, it is claimed, will make electric power at once available for heating and cooking. In the coast cities, particularly, there is need for modern methods of domestic heating. Once the electric supply is available, it is believed, there will be an increasingly rapid growth in demand.

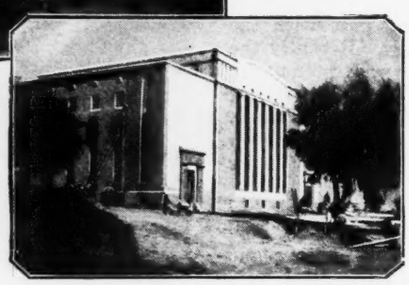
Besides the Jordan, the Jarmuk River,

which flows into the Jordan below Lake Tiberias, is included in the development project. This river, having an average flow of about 180 cubic feet a second, gains importance as part of the general scheme from the fact that its waters can be stored at high elevation. Thus they can be led for irrigation purposes into waste lands that stand 1000 feet above the level of Lake Tiberias. To this land the water from the Jarmuk can be carried by siphoning; it can be pumped to higher levels.

The second step in the enterprise will be the drainage of marshes and impounding of the Jordan springs. Thus, agricultural reclamation of marsh lands will be followed immediately by irrigation and subsequent housing and transportation development. As a minor feature of the scheme, domestic water supply will be provided throughout the region covered by the hydraulic works.

Important as these projects must prove to the whole of Palestine, they are regarded as merely preliminary to the ultimate development of the Holy Land. Probably $100,000,000, it is estimated, will be spent eventually in the restoration of Palestine. Nine power stations, a veritable network of irrigation canals, electric railways, dams, houses, manufacturing plants, wharves, warehouses, and large scale drainage of the marshes already are planned. They await only the adjustment of the population to the new order that will be ushered in by the operation of the power station on the Jordan and the reclamation of the waste lands of the valleys.





Above: The Jarmuk waterfall of the Jordan—one of the sources of power to be harnessed. At the right: The first of Palestine's power stations at Jaffa on the Mediterranean shore. This oil-burning plant eventually will be used as an auxiliary station

Winston Churchill, Secretary of State for the British Colonies, and others occupying high position in the British Government have expressed themselves with unstinted enthusiasm regarding the Palestine reclamation work.

Government restrictions, as has been mentioned, have been placed on the project. The company organized to pursue the work has been limited to a maximum profit of 12½ per cent, and the Palestine Government has been authorized to purchase the undertaking after 37 years or at the end of each 10-year period thereafter.

Many claim to see in the project a first step toward the realization of the Zionist dream of re-establishing Palestine as the fatherland of Jewry—a dream that has survived the centuries.

Improved Kite Camera Simplifies Aerial Photography

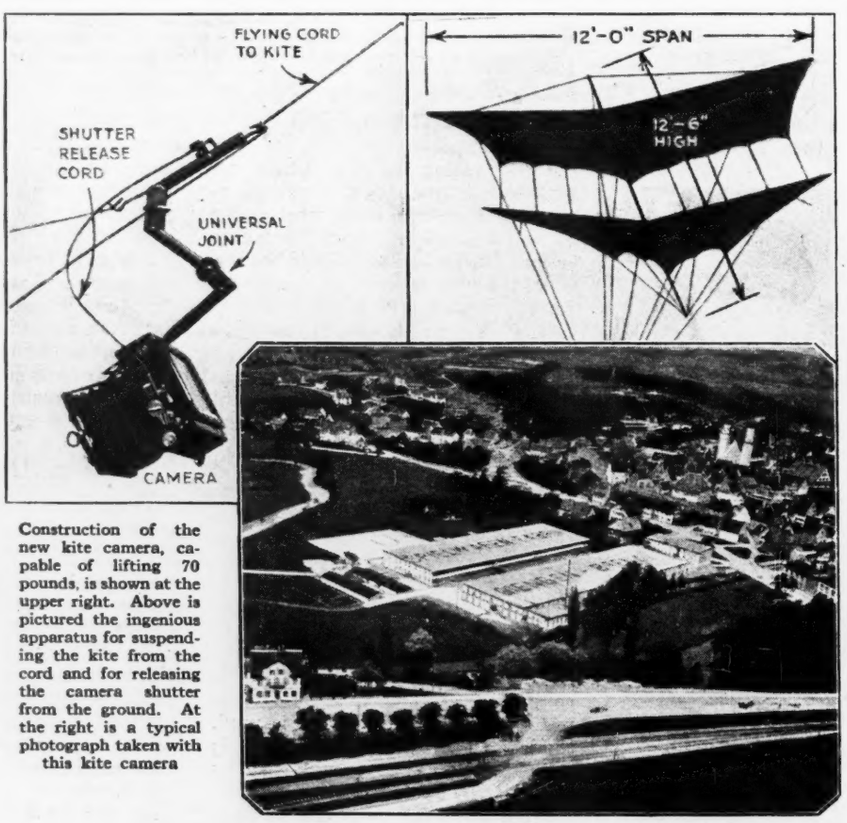
MUCH of the difficulty usually encountered in making aerial photographs by means of kites is said to have been overcome by an unusual kite design and ingenious apparatus for suspending the camera that recently has been perfected in Germany.

One of the chief handicaps to kite photography in the past has been lack of sufficient lifting capacity to carry the camera aloft and hold it steadily in position in light or fickle winds. The new camera, it is claimed, exerts a lift of 72 pounds in a fair breeze.

A distance of about 170 feet is allowed between the kite and the suspension gear of the camera. To direct the lens to any desired point while the camera hangs from the kite string, a special suspension gear has been evolved consisting of three tubes linked together. Small gear wheels are fitted to the joints, and into the teeth of these wheels flat springs engage, holding the camera at the desired angle.

To assure a gentle release of the camera shutter, without shock, an unusual release gear has been devised. In addition to the main kite cord, a shutter release cord from the ground is tied to the end of a plunger that is held within the upper tube of the camera rig by means of a spiral spring. The other end of the tube is fastened to the main flying cord.

When the plate is to be exposed, the operator gradually slackens the flying cord and the release cord is taken in so that the plunger is gently pulled out of the cylinder. This causes a trigger projecting from the plunger to strike the button at the end of the regular camera shutter cable and in consequence the desired exposure is made, the shutter being released again whenever the operator so desires.



Construction of the new kite camera, capable of lifting 70 pounds, is shown at the upper right. Above is pictured the ingenious apparatus for suspending the kite from the cord and for releasing the camera shutter from the ground. At the right is a typical photograph taken with this kite camera

Here are some precautions that must be observed in air photography:

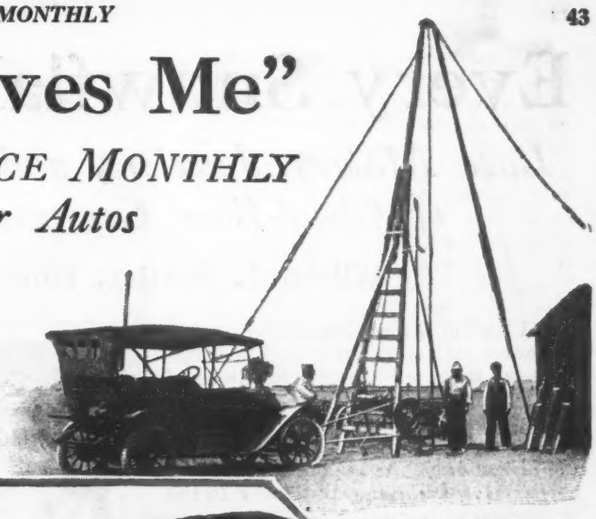
Aerial photos should be attempted only in bright sunshine, else they will have a flat look.

If the camera is a focal plane one, the shutter should be adjusted to the shortest exposure—about one thousandth of a second. The lens should be used at full aperture.

For development, a fairly concentrated developer should be used, and the development must not be broken off too soon.

"How My Car Serves Me"

Prize-Winners in POPULAR SCIENCE MONTHLY Contest Find Novel Uses for Autos



FROM the many contributions submitted in POPULAR SCIENCE MONTHLY'S "How My Car Serves Me" prize contest, announced in September, the judges have selected the following three as representing the most ingenious ways of putting the family automobile to work in addition to its regular duties in transportation. The winners are: First Prize, J. M. Schofield, Stockton, Calif.; Second Prize, E. W. Tee, Brooklyn, N. Y.; Third Prize, Samuel D. Lamis, Hannibal, N. Y.

By J. M. Schofield
Stockton, Calif.

First Prize, $20

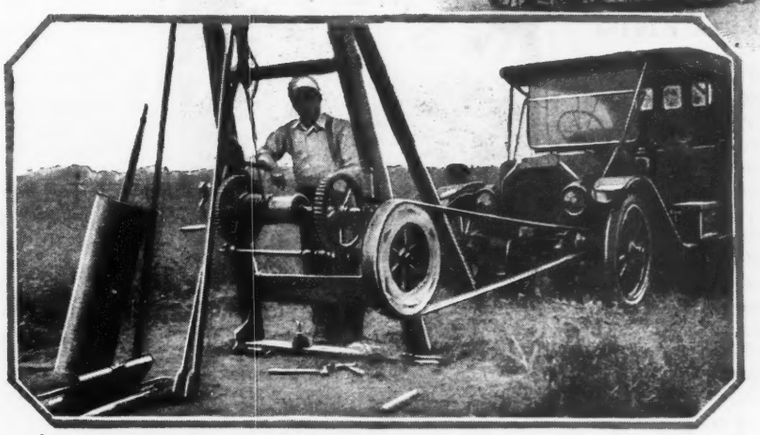
FOR eight years I have run a pump and well-digging tools with my Overland. On the way to and from jobs it pulls a four-wheel trailer loaded with from 2500 to 3500 pounds of digging tools and casing, and does it at from 15 to 20 miles an hour.

To raise the derrick, I attach guy ropes to the front of the car and back it up the proper distance. The crankshaft is extended to the front of the radiator, and I use a pair of bevel gears and a short shaft to run the belt pulley between the chassis and the front wheel. The belt then is run to the derrick pulley.

A friction plate is used in hoisting tools, pumping sand, drilling, and lifting full augers for emptying.

If the belt gets loose, I place a jack against the front axle and push the car back until the belt is tight enough. When I am through for the day, I throw off the belt and go home. When the car is not serving as a stationary engine, I loosen the boxes and pull the bevel gears apart. The belt pulley does not interfere in the least with turning the front wheel.

My car, I believe, can be used to drive any belt-driven machine that does not require more than 27 horsepower.



J. M. Schofield, of Stockton, Calif., using his Overland car to operate a well-digging outfit. The engine also raised the derrick shown in the upper photograph

By E. W. Tee, Brooklyn, N. Y.

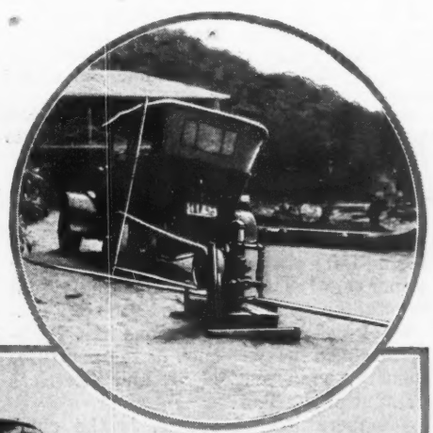
Second Prize, $10

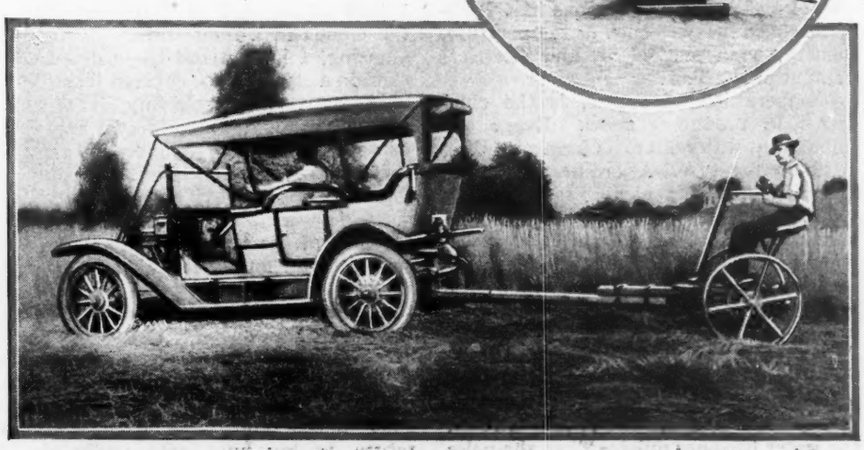
WHILE staying near a lake in the country last summer, we began to experience a shortage of spring water. With careful management, the supply seemed to be sufficient for drinking purposes, yet we had to find some means of providing ourselves with water for washing and other household uses.

We were some distance from a lake, and we could easily see that it would be a tiresome job to carry up water every day to the house, which was situated halfway up a hill.

Finally, we decided to try to use our old Oakland to supply the power to pump up the water. This proved to be entirely satisfactory, and more than came up to our expectations.

A tire was removed from the rear wheel, and the rear end of the car was raised by strapping it to a long pole driven into the sand, thus permitting the rear wheels to revolve. A temporary belt was made, and power thus was obtained to drive the pump that easily supplied all the water required.





How Samuel D. Lamis, Hannibal, N. Y., used his car in place of a team to mow the hay. The inset shows how the car of E. W. Tee, Brooklyn, N. Y., pumped water from a lake to his hillside cottage

By Samuel D. Lamis
Hannibal, N. Y.

Third Prize, $5

A FEW weeks before my hay was ready to cut, at the close of a long, dry season, several heavy rains started the grass growing at the bottom. When I came to cut the crop, I found the grass at the bottom so thick that the team could not keep up a sufficiently strong and steady pull. So the knives kept plugging up every few feet.

I decided that probably my 1911 Buick had more pep than the horses, so I put a stub tongue on the mower and hooked it to the car. A man rode the mower and I drove the car. After a very short time of experiment, I knew I had solved the problem.

The field was stony in places, and a part of it had a 10 per cent grade, but neither handicap seemed to affect us. I did not have to stop once for plugged knives and I cut the field much quicker than I ever did with the team, even when the hay was easy to mow. I ran in low all the time yet the engine did not heat up any more than a tractor.

Every Snowflake a Master Design

Lace Makers, Jewelers, and even Bakers now Copy Photographs of Cloud-Born Crystals as Patterns for Their Wares

By Wilson A. Bentley, *World's Foremost Snowflake Photographer*

INVENTIVE man has learned to improve on Nature's processes in countless ways—in the production of larger and better crops; in turning the energy of streams and waterfalls into electrical power to give him light and to run his factories. Yet in one field Nature never has been surpassed. That is in the production of beauty.

Nature is the master artist. Man can only copy crudely the patterns she designs in infinite variety. And nowhere is this supreme artistry more marked than in the tiny snow crystals that fall in countless numbers from the dark snow clouds of winter.

For 41 years I have been studying and photographing snowflakes; yet even now, each new snowfall adds thrilling interest to my search for wonderful new forms of beauty. I think that is because in all those 41 years I never have found two snowflakes exactly alike. Think of it! Every time I focus my camera on a snowflake, I do so with the knowledge that I am recording an intricate and beautiful design that never before existed in the world!

Thrilling but Practical

This unending thrill of new discovery always has been ample reward for the time and labor I have spent in pursuing my hobby. Yet in recent years added interest and fascination have come through the fact that my study of snowflakes and the photographs I have made of them have found practical usefulness in industry and in scientific research. Incidentally, my hobby has developed a real financial value.

For example, a lace manufacturer discovered in my photographs of snow crystals an opportunity to copy their original designs in the manufacture of his product. He bought a number of the photographs from me, and from them fashioned lace in the patterns that Nature, the master artist, had formed by hurling tiny drops of water through the winter air. Next, a jeweler realized the possibilities of imitating my captured snow gems in gold and precious stones. Wallpaper designers, makers of silks and other fabrics, metal workers, wood carvers, manufacturers of glass and chinaware—all have purchased my snowflake photographs for use in patterning their wares. And recently I sold some pictures that are to be used as models for cookies!

The fact that no two snowflakes ever are alike, or ever can be alike, in form and texture is one of Nature's great wonders. Yet by close study of the formation of these crystals, science explains why this is so. Each of the minute crystals of water vapor that fall as snow takes its individual crystalline form from a definite combination of atmospheric conditions that it encounters as it falls—such as temperature, density, wind movement, and electrical content of the air.

Temperature, of course, is the chief factor in producing snow. Every one knows that water alters its form according to its temperature. At ordinary temperatures it is a liquid; at high temperatures it becomes a vapor—steam; at low temperatures it becomes a solid—ice. Even when water is in the fluid state, the negative and positive poles of its molecules tend to arrange the molecules into crystals. At the higher temperatures, however, these molecules dart about under the influence of heat, making it impossible for their poles to hold them in crystal form.

When the temperature is low, though, the water becomes quiet. Then the poles draw the molecules together and the crystals are formed. Minute variations of these lower temperatures definitely alter the forms that water assumes when it enters the solid state. To this fact chiefly is due the marvelous diversity of snowflake patterns.

Thus, the natural form of the water crystal—ice—is a triangle. Snowflakes, however, rarely form in this design—only at unusually low temperatures when the molecules of water from which the snowflake forms is transformed slowly into the solid state. When the freezing temperature is higher, the molecules become a solid more quickly and tend to assume a branching form. Almost invariably this form will be some variation of a six-pointed star.

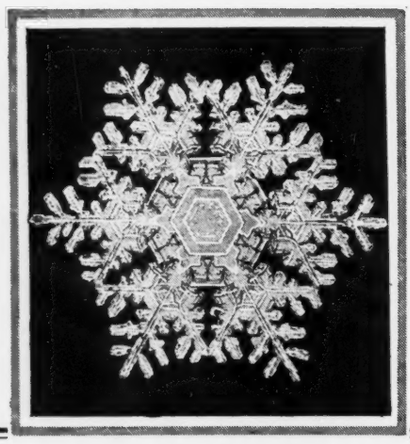
Meteorologists especially have become interested in facts regarding the nature of snowfalls which my work has revealed. For one thing, the forms of the crystals vary remarkably, although not by definite rule, in different portions of any storm area. For example, on the eastern edge of a storm, columns and plates often are prevalent; the southern portion produces branching stars and sometimes sleet and granular forms; the center portion, granular forms; the western section branching stars and plates, and the northern part columns and plates.

When Stars Are Formed

Medium to rather scattering snowfalls, rather than heavy storms, produce the most beautiful forms. Branching stars occur most often during mild weather, while plates and columns fall generally in cold weather storms.

It is astounding to find that in zero weather tiny bits of water from 1/300 to 1/4000 of an inch in diameter exist in the clouds in a fluid state. Even more amazing, I have found these droplets to contain a crystal core, covered by a film of fluid water. Why these tiny bits of water fail to freeze in the coldest weather of winter is a mystery of cloudland to puzzle the keenest scientific mind. Hardly less interesting is the evidence contained on some of the snow crystal faces that certain portions of them also once were covered with films of fluid water that later crystallized in the typical scalloped, rounded form characteristic of massive ice crystals.

Some falls of snow have yielded as many as 50 beautiful pictures; others none at all. In all, I have made more than 4000 photographs, and each winter I return to my hunt with undiminished enthusiasm.

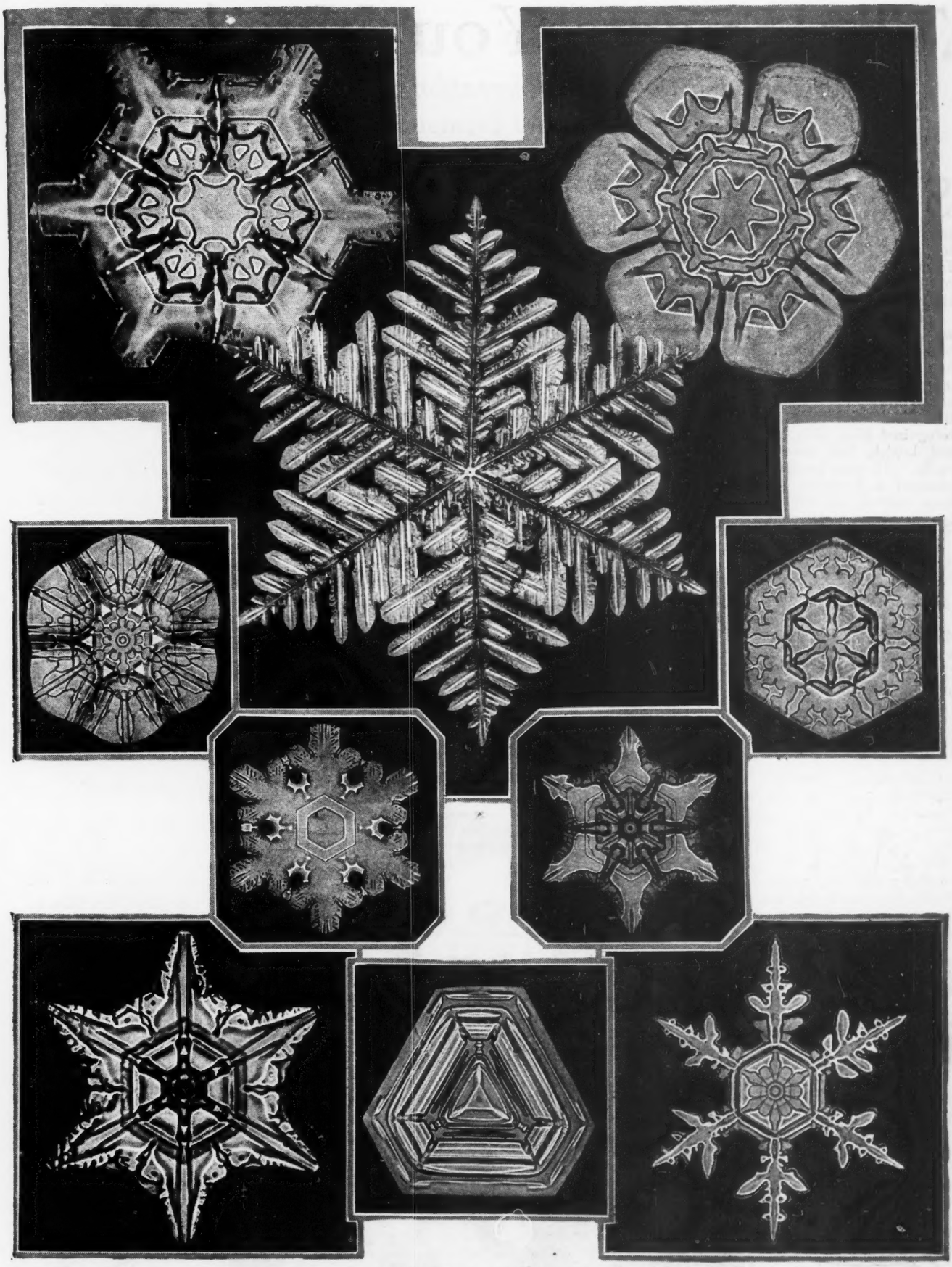


A Hobby that Never Grows Old

"UNTIL I was 16 years old, a snowflake to me was just a snowflake," says Wilson A. Bentley, relating how he first began to pursue his fascinating hobby of photographing crystal gems from the sky. "Like most people, I thought snowflakes all were alike, except that some were larger than others. Then my parents gave me a compound microscope, and in my search for interesting objects to view through this magic glass, I soon discovered the almost unbelievable beauty of snow crystals. The study of snowflakes immediately became my hobby, and it has remained my hobby ever since."

Mr. Bentley is a farmer. His home is in Jericho, Vt. Here during his spare hours in the winter he makes his remarkable photographs, often working out of doors many hours at a time. In recent years, with a growing demand for his snowflake pictures by manufacturers, designers, and scientists, his hobby has developed a financial value; yet he has been content to let his work among the crystals remain a pastime and to draw his livelihood from his farm.

During the 41 years he has followed his unusual hobby, he has photographed more than 4000 snowflakes—and never has he found two of them exactly alike.



Nature's Snow-Crystal Designs for Laces and Jewels

IN MAKING these unusual photographs of snowflake forms, Mr. Bentley first catches the crystals on a blackboard as they fall. If the snowfall takes place before daylight, he removes a vertical section of snow from the ground, places it on his blackboard and brushes the crystals apart. After he has selected his subjects, he places them on a glass slide and photographs them by transmitted light, using a photomicroscopic camera. His microscopic camera magnifies the snowflakes, in all their intricate beauty, from eight to 60 diameters—that is, from 64 to 3600 times

The Sports You Need Most

For Every Job there's a Recreation to Keep You out of Ruts

By C. Ward Crampton, M.D.
National Authority on Recreation and Health

SUCCESS can become one of the most fatal of all diseases.

The winning of success demands intense concentration. It means that a man must put his whole self into his work. In pursuit of success he takes himself out of life; he not only gets into a rut, but the ruts get into him and wear him down.

I have in mind an old boyhood friend who, from the day he left school, embarked on a spectacular career that in a few short years carried him to financial independence. The other day I ran across him on the street. It was the first time I had seen him in 15 years. I hardly recognized him. His face, once tanned and boyish, had become the color of putty. His once handsome features had assumed a hawklike sharpness. Deep lines marked his forehead and gave a drooping twist to his mouth.

A One-Sided Man

We talked of the years that had separated us.

"Doctor," he said, "I have given everything I have to get where I am. I have worked night and day, year in and year out. And yet, do you know, now that I have all that I was after, I'm not happy. I don't enjoy my food. I can't sleep well. I don't enjoy the company of others. All I can think of is my business. What's the matter with me, anyway?"

There was a certain tragic look about him.

"I know what's the matter with you," I told him. "You remind me of an automobile wheel spinning in the mud. The faster you go, the deeper you sink in the rut. And if some one doesn't hurry with a derrick, you're going to get stuck so fast you can't budge. The trouble is you've forgotten how to play. What you need is to get out for some fun and exercise."

All of us who are interested in our work, and are eager to succeed in it, are in constant danger of falling into the same kind of rut. And the way to get out is to re-establish the balance of life that has been overturned by too much concentration. It is the opposite of *concentration*—it is *recreation*.

Those who do not re-create themselves dry up like mummies, wrapped in themselves, all dusty and shriveled inside. They are half dead while they are alive, and they die early. As a New York physician declared recently to a patient: "It is a case of recreate or wreck."

There are, of course, many kinds of recreation, and the kind that may suit you may not be suitable to your neighbor. But you will go a long way toward making a correct choice if you pick for your recreation some form of activity that is absolutely different from your daily work.

If your work is mainly muscle work, find some mind-testing recreation, and play some game that makes you use your muscular equipment in some entirely different fashion.

If your work is mainly with your head, turn to vigorous muscular activities.

If you work indoors—go out.

If you are out of doors all the time—like the postman or the structural ironworker—stay inside.

If you sit or stand at your work, walk, run or dance for recreation.

If you are continually meeting many people, seek seclusion.

If you work alone, seek congenial company.

Keep Yourself Well Balanced

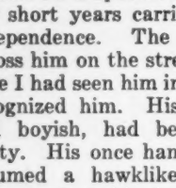
If your work is quick, intense, and exciting, seek quiet.

If it is dull and monotonous, find some activity that is rapid and intense.

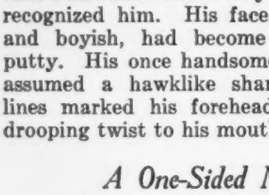
If you have a white-collar job, put on a flannel shirt.

If you have a flannel-shirt job, a white collar as a change may have its merits.

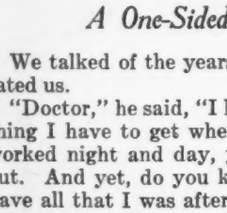
Change your clothes, change your mind, change your attitude—but, above all, get the play spirit. Nature has provided us all with a desire to get into the game. Some of us feel that we may have lost that desire. Games, particularly of the athletic type, employ the whole mind, body, and emotions.



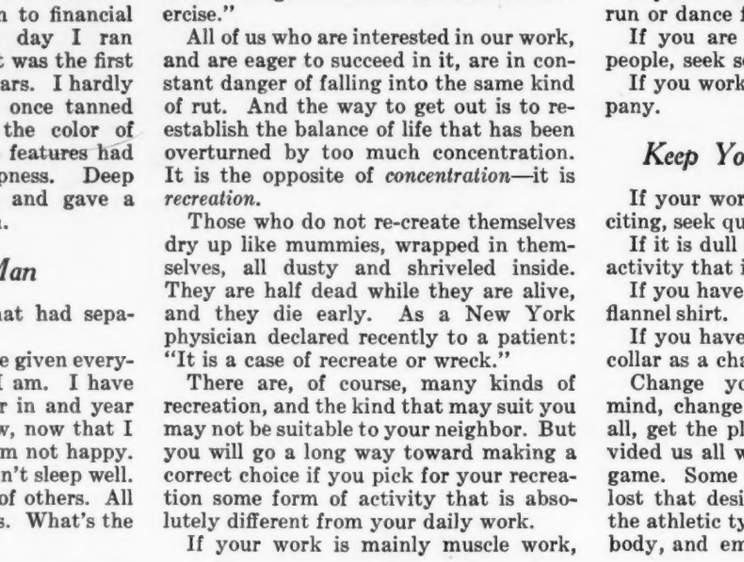
He needs basketball to make him run and jump, to knock him around ruthlessly with other men



He needs to rough it out in the open; to learn how to enjoy a roaring campfire

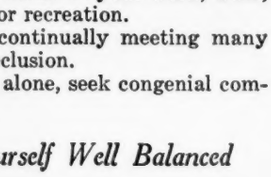


He needs to spend his week ends in the woods on the shore of lake or river, to learn all about the world out of doors

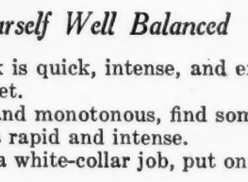


All tired out—the office man taxes his brain, using few muscles

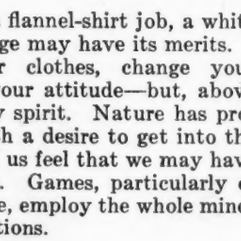
Sketches by Doctor Crampton



He needs to play baseball for outdoor fun and vigorous, exciting exercise



Chopping wood will strengthen his muscles, his lungs, and his heart

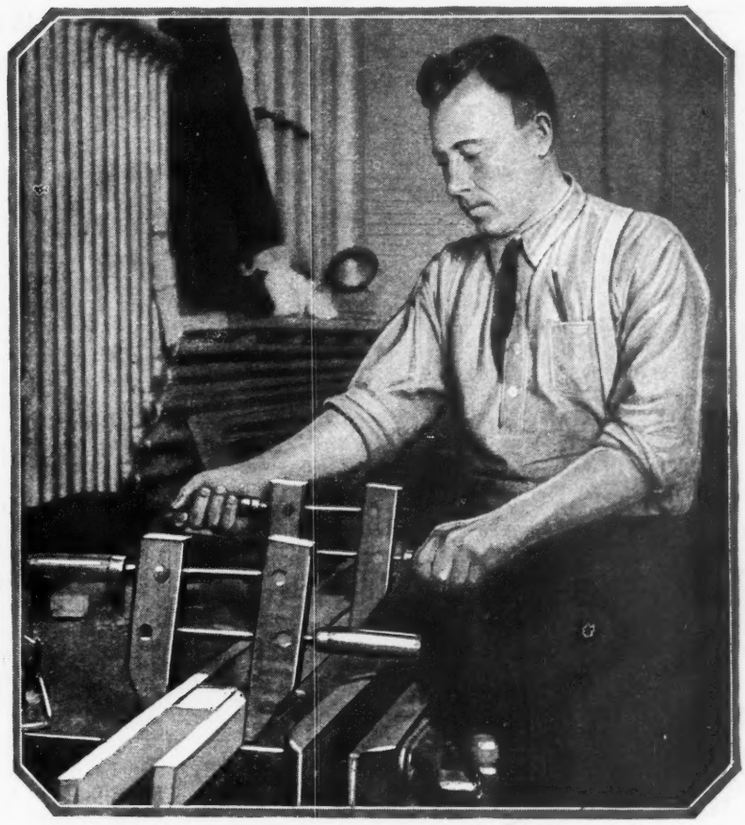


Mountain climbing will take him away from his worries and re-create him

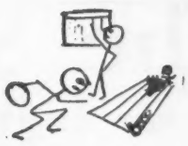
He needs handball to loosen up his stiffened joints and limber his unflexed muscles

He needs boxing for rapid, exciting, and vigorous exercise

A quiet game of checkers develops his brain

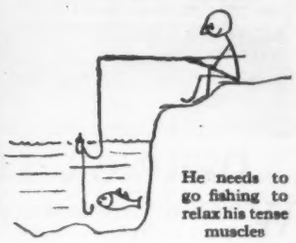


The flannel-shirt man works indoors at a job that requires taut muscles



He needs bowling to straighten his back

Reading an exciting adventure story stirs his blood and fires his imagination



He needs to go fishing to relax his tense muscles

Take the man in an office job, say a clerk 25 years of age, who has sedentary indoor work eight hours a day, in an office where he sees only three people—the boss, the stenographer and the office boy. What is the one best recreation for him?

Basketball makes him run and jump. It takes him out of himself and throws him (sometimes violently) among his fellows. His daily work is quiet and uneventful. Basketball is full of excitement. His work uses only a few muscles in the body. Basketball uses them all. He can sit at his desk for the whole day and not be much more than a neat, tidy automaton. Basketball musses him all up, brings out his virile qualities, makes him a shouting, vigorous man in action—every fiber of his being on the job.

Sleep—a Health Builder

Moreover, he gets a shower bath and a rubdown afterward, and he comes out of the gym tired, glowing, and stimulated, ready for a solid night's sleep of perfect reconstructive repose. He has been re-created.

Baseball, tennis, handball, boxing, and wrestling, too, are good choices. All supply the vigorous exercise and stimulating sport that the white-collar man needs.

But aside from competitive games such as these, an ideal source of recreation is out in the woods, under the skies, along the shore of some lake or river. If you are a white-collar man, learn how to walk and become a hiker. Find a lake in your vicinity. Make your camp and cook your supper on the shore, skate there or swim, according to the season. The man who can start off with a pack on his back and spend the week-end in the woods, independent of a hotel, has taken a big stride toward becoming a real, all-round, full-grown man.

All this applies especially to every man who works indoors and does not employ his muscles vigorously — the school teacher, bookkeeper, clerk, salesman, editor, executive, manager, buyer, broker, or banker.

Suppose you are a machinist. Your job calls for constant application, requiring a good eye, steady hand, and taut muscles. When you get through, you are tired. Your muscles are cramped. Your back is bent over. The chances are it will stay that way, for it obeys the general law that the body structure assumes the position in which it is most exercised.

I have seen hundreds of men who have been engaged in mechanical work for years. They become strong, but hard and stiff, and stiffness is just another kind of weakness. You need, if you work at one of the manual trades, a thorough livening-up to overcome this hardening process.

Your game is *handball*. It is interesting, rapid, and vigorous and will loosen up any or all of your joints when the rivets tend to get rusted in.

Your next best recreation during the indoor season will be either boxing or wrestling. Go to some gymnasium where you can get good instruction and see clever work done. Learn these manly sports from the ground up, for boxing and wrestling are the greatest of all-around man-making games, and belong in every man's life.

If you want to be a well-rounded man physically and mentally, you need to develop the other side of you. It is a good thing occasionally to give the muscular equipment a rest for an evening and sit down to a quiet game of chess, checkers, or cards. These help to develop a useful part of your anatomy—your brain.

ARE you "all in" when you go home at night after the day's work? During the daytime are you pursued by the "tired feeling" that robs work of its zest and deadens ambition?

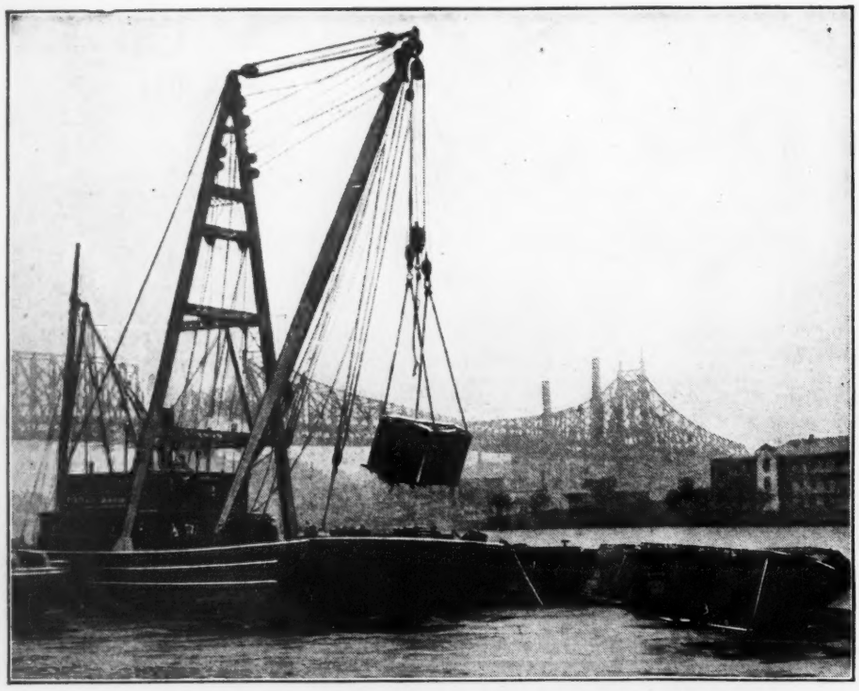
In an early issue of POPULAR SCIENCE MONTHLY, a noted health authority will explain the scientific secrets of fatigue and will tell how you can conquer it.

Reading that Stirs the Blood

For the vigorous, active man, who is tired at night, there is no finer recreation than occasionally stretching out in an easy chair and reading an exciting story of romance and adventure. This stirs his blood; makes him thrill with the dangers, struggles, and victories of fiction, and he participates in stirring events that he could experience in no other way.

Similarly, you can find enjoyment in watching others play when you yourself cannot play. If you cannot play baseball, go see a good game once in a while and "root" for one of the teams. Knock 'em "over the fence" with Babe Ruth. If you can't go to a game, follow the fortunes of your favorite big league team through the season. If you are interested in tennis, follow it up. Go to the big tournaments.

Get into the game. Recreate. It holds big profits for you.



DERRICK LIFTS CARS FROM RIVER

WHEN a barge loaded with freight cars struck a buoy near the Queensboro Bridge, New York City, recently, the cars were plunged into the East River. The photograph above shows how the cars were lifted one by one from the water by a giant derrick mounted on a huge barge anchored in the river.

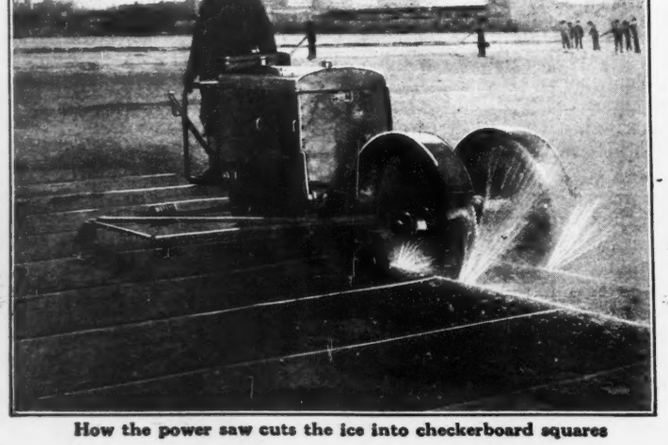
Handy Envelope Is Sealed by Postage Stamp

A SELF-SEALING envelope, easily opened, has been invented by Ervin W. Weigand and Arnold B. Ogden, of Jefferson City, Mo. To the flap of the envelope, which is at one end and which folds over the face, is attached a small tab. This is inserted beneath two other tabs at the upper right-hand corner of the envelope.

When the stamp is pasted over these joining tabs, the envelope is sealed. To open, it is necessary merely to pull a tab attached to the flap and projecting beneath the edge of the stamp.

POWER SAW CUTS ICE IN SQUARES

A POWER saw for cutting ice has been designed by a New York manufacturer to replace four pair of horses and six men. Power from a four-cylinder gasoline engine is transmitted to two vertical circular saws at the rear through a series of gears and a universally connected shaft swiveled to swing vertically.



How the power saw cuts the ice into checkerboard squares

The operator, standing on a frame in front, keeps the cutter in line by following the previous cut with a guide pin. The friction of the saw as it cuts its way through the ice serves to move the machine forward on its runners.

After the entire ice area has been cut in checkerboard fashion, the machine is removed and workmen armed with picks and ice saws break off the cakes.

Pistol Welding Torch Is Released by Trigger

THIS oxy-acetylene torch shaped like a pistol, with a trigger release, was invented in Germany. It is ruggedly built, so as to eliminate all danger of escaping gas.

Out-of-the-way corners that are inaccessible to other welding torches can be reached easily by this compact tool, it is claimed.

New Automatic Sprinkler for Fire Prevention

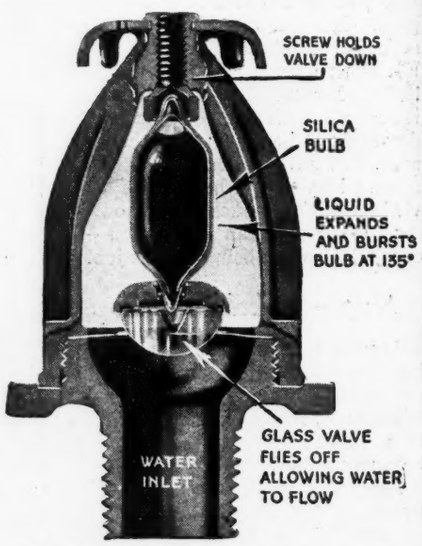
OPERATION of a new type of automatic sprinkler head is accomplished by a liquid that is sensitive to heat. It has been developed for fire prevention installations and is said to be non-corroding and more sensitive to heat than the older types.

The thermally responsive part of the new head is a silica bulb nearly filled with a red liquid. As the temperature rises it expands the liquid. When a predetermined temperature point is reached—usually about 135° F.—the bulb bursts under the pressure.

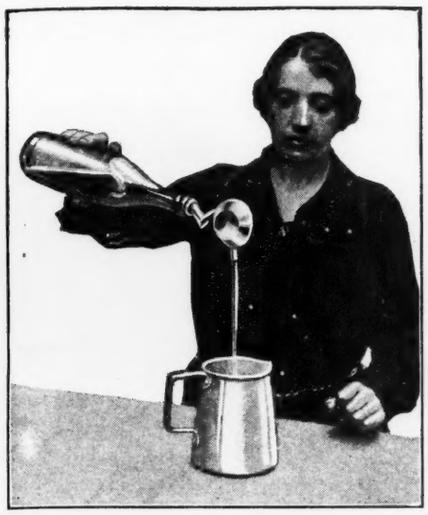
Normally, the bulb is so adjusted as to hold a glass valve against the water inlet. When the bulb bursts, the valve flies off, allowing the water to flow.

Heretofore, solder heads have been used exclusively, because solder melted at a lower temperature than did any known alloy strong enough to keep the sprinklers watertight. The new head, operating on a fundamentally different releasing principle, is said to be effective at much lower temperatures, attacking fires earlier.

The first industrial plant to install the new heads is the Thomas A. Edison factory at West Orange, N. J. They are in a room where celluloid cylinders are stored.


SCREW HOLDS VALVE DOWN
SILICA BULB
LIQUID EXPANDS AND BURSTS BULB AT 135°
WATER INLET
GLASS VALVE FLIES OFF ALLOWING WATER TO FLOW

Bursting of the sensitive bulb releases the water inlet valve, allowing the water to flow



New Bottle Stopper Pours Specified Quantities

AN INGENIOUS bottle stopper that pours an exact quantity—from one to five teaspoonfuls—into an attached container is a recent household convenience invented in France. To pour this quantity a second time, the bottle first must be placed upright.

Hot Bottle Heats Itself when It Is Needed

DESIGNED for household convenience, a new hot bottle, filled with a harmless chemical instead of water, stays cold, it is claimed, until you need heat, and then becomes hot almost immediately at a slight manipulation of the stopper.

Boiling the bottle charges it with heat. The bottle then cools, while the chemical contents hold sufficient latent heat to meet any need for a hot-water bottle.

It can keep food warm on a motor trip or, when no heating device is handy, remain cool until heat is needed. Since it is built of metal, it cannot be punctured, and it is said to be more durable than rubber.

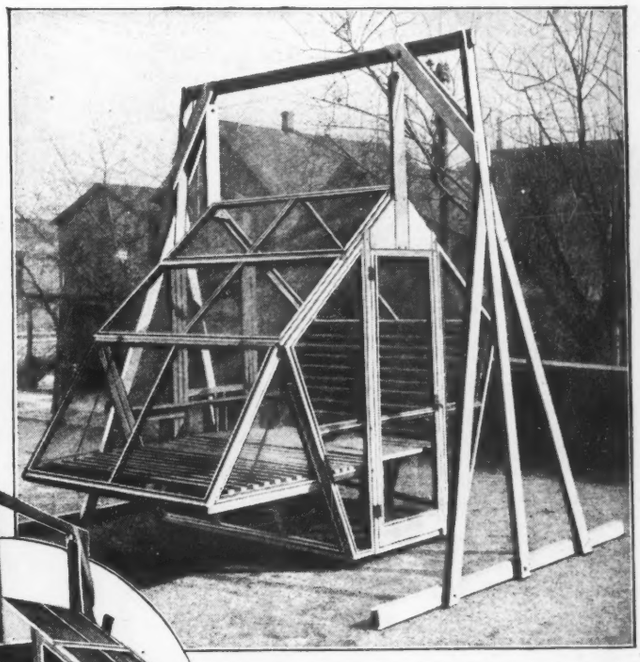
Skyscrapers Shrink in Winter, Tests Show

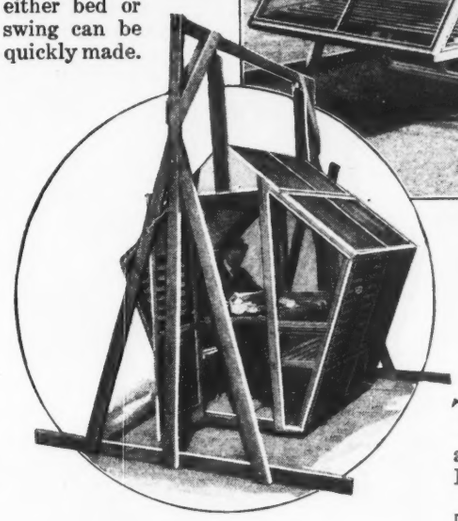
NEW York skyscrapers are from 1 2/10 to 1½ inches shorter in midwinter than they are in summer. This fact has been revealed as the result of a study of skyscrapers recently made by the planning service of the National Association of Building Owners and Managers. The figures were arrived at by calculating the expansion and contraction of steel. In the Woolworth Building it was found that each degree change in temperature makes a difference of .061 inch in the structure.

OUTDOOR SWING AND BED COMBINED

FOR the person who enjoys the out-of-doors in winter this combination swing and bedroom has been devised by Bernard H. Witte, of Chicago, Ill. A glass frame completely incloses it. A portion of this frame behind one of the seats may be swung outward, while the back of the seat can be swung to a horizontal position, forming an extension for a bed.

The adjustment for either bed or swing can be quickly made.





Showing how one seat of the glassed-in swing (at the left) is swung out to form a floored extension for the bed

Pincushion Attached to Sewing-Machine Arm

PINS have been made convenient to the fingers of a housewife operating a sewing machine by a doughnut cushion encircling the arm of the machine. It is not necessary to turn about to find a pin or to leave a cushion exposed where the forgetful hand may be pricked.

By means of an inconspicuous slit in one side, the cushion can be slipped easily over the machine arm. It does not at all impede the operation of the machine.

Cushion within easy access of seamstress

Sensitive Fire Detector Sounds the Alarm

THIS remarkable fire detector, actuated when the temperature in any part of a building it protects reaches a 106° Fahrenheit, indicates on a central switchboard the exact location of the danger point. Simultaneously it sounds an alarm bell at the switchboard and one at the nearest fire station.

The fire detector, showing alarm signals

A white control light burns constantly on the switchboard. Should this light burn out, or should a wire break or a connection get out of order, a distinctive trouble alarm is sounded. This, of course, is heard only at the switchboard.

When the temperature reaches 135 degrees, an alarm is sounded loudly outside the building and the word "Fire," illuminated through red glass, calls the neighborhood's attention.

Honey Prevents Freezing

A MIXTURE of honey and water in the radiator of an automobile will prevent freezing in winter, according to experimenters at the New York State College of Agriculture at Ithaca.

Oddities in the News

THE SMALLEST MONKEY IN CAPTIVITY

Born in the jungles of Brazil along the Amazon River, "Paradox," a full-grown, healthy marmoset, weighs only four ounces. He is the smallest monkey in captivity, and is the pet of Miss Ruth Clifford, of Los Angeles, Calif., who is shown at the right holding him on her wrist.

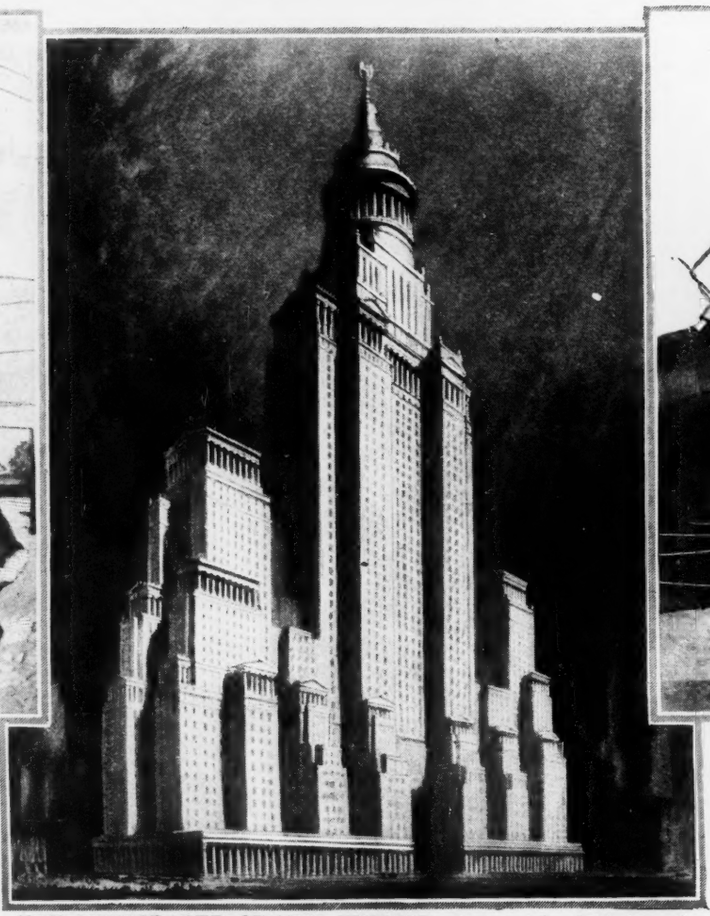
"Paradox" is just three years old. Grapes and figs, to which he became accustomed in his Brazilian jungle, are his favorite foods. Every day he consumes his own weight of them. Like all marmosets, he is extremely sensitive to cold.

NEW THRILLS FOR SKATERS

Made from a bicycle frame, a motor wheel, and a pair of steel runners, the ingenious motor-skating machine shown at the left offers new thrills. Propelled by the friction wheel driven by a small motor, the machine scoots over the ice at 30 miles an hour, pulling the skaters. It is the invention of Thomas Avoskin of New York

DEER BEGS A MEAL

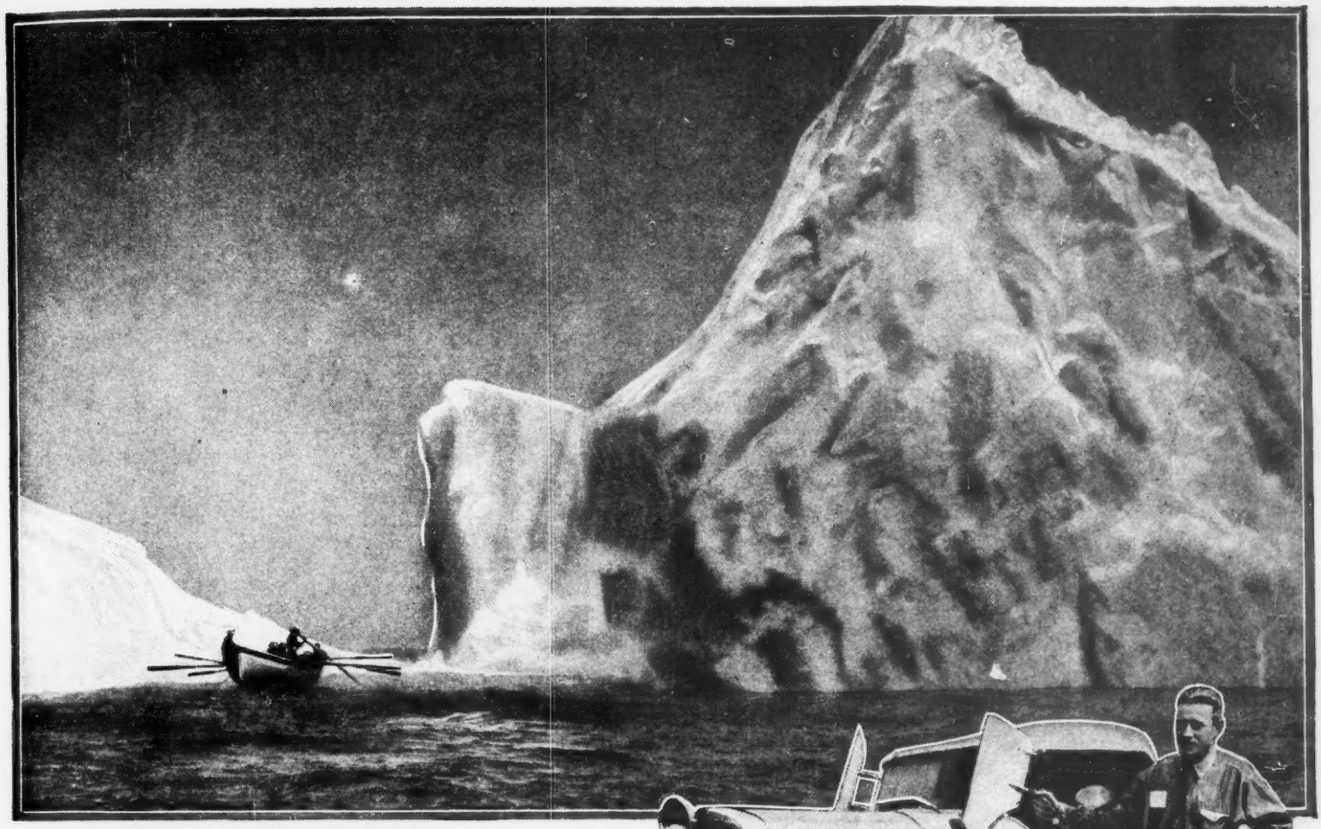
When winter snows lie deep, the American white-tailed deer often visits the outskirts of city or town in search of food. Above is a typical scene in Duluth, Minn., where the deer become so tame as to beg meals from doorsteps of suburban homes



THE SKYSCRAPER OF THE FUTURE, designed by Helmle and Corbett, New York architects. The building, occupying a city block, will be composed of units rising to a 60-story, 1000-foot central tower

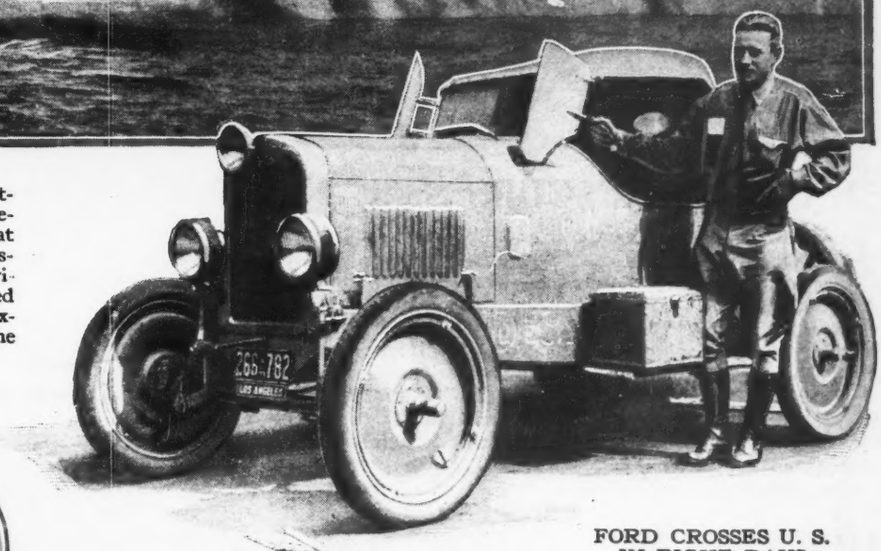
NEW AIRCRAFT GUN

The newest development in airplane armament is this unusually flexible Browning 30-caliber machine gun. It is mounted on a specially designed revolving mount that enables the gunner to train the weapon in almost any desired direction or angle



DYNAMITING AN ICEBERG

A boat crew from the United States coast-guard cutter *Tampa* is shown here preparing to dynamite a huge iceberg that has floated into the path of the trans-atlantic shipping lines, menacing navigation. Dynamite mines were inserted in the great mountains of ice and exploded by a fuse after the crew had gone



FORD CROSSES U. S. IN EIGHT DAYS

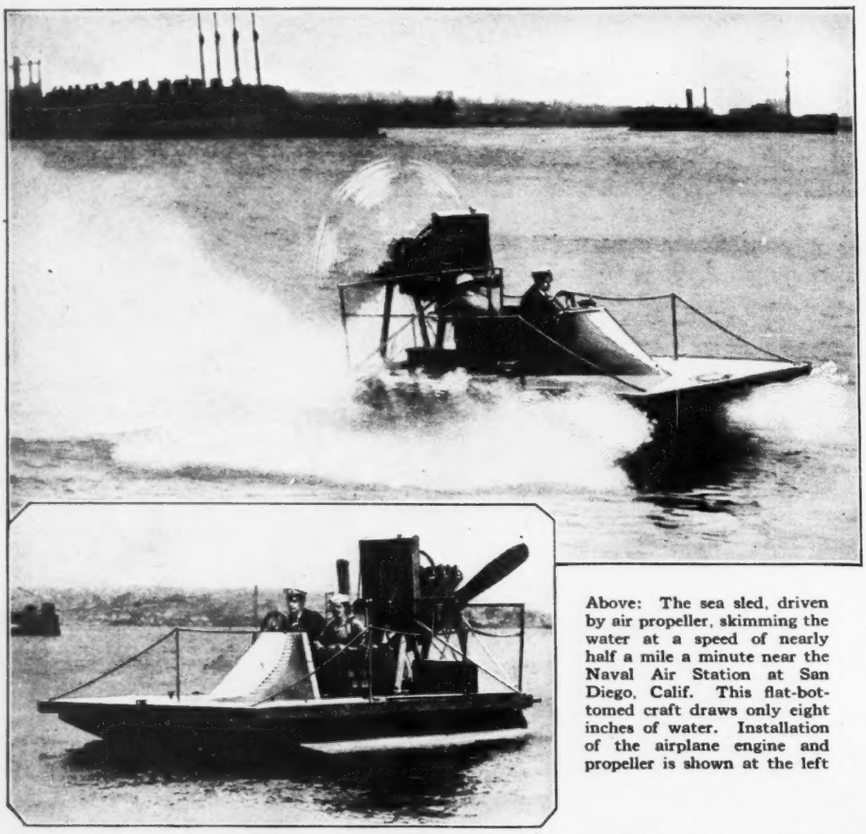
Record time for a trip across the United States in a Ford is claimed by F. G. Gegoux, who recently drove from Los Angeles to New York City in eight days and six hours. Gegoux is shown above standing beside his mud-spattered car. Note the special roadster body, designed to give protection from the severest weather

A PERISCOPIC MIRROR

No blemish of make-up escapes the woman who is armed with the hand mirror shown above, displayed at a recent perfumery exposition in New York. This triplicate mirror reveals the hang of the owner's earrings, the arrangement of her back hair, as well as the amount of powder on her nose

USES MOTORCYCLE AS DELIVERY VAN

Delivering a seven-piece dining-room suite, all loaded on his motorcycle side car, is just one small item in the daily business of H. Farrar, a furniture dealer of London, England. Finding that the slow moving van and delivery wagon were not speedy enough for his trade, he reinforced his side car, strapped the goods on top, and drove away. After using this method of delivery for 18 months, he says it's a real economizer of time and money



Above: The sea sled, driven by air propeller, skimming the water at a speed of nearly half a mile a minute near the Naval Air Station at San Diego, Calif. This flat-bottomed craft draws only eight inches of water. Installation of the airplane engine and propeller is shown at the left

SEA SLED RESCUES STRANDED PLANES

TO SOLVE the problem of rescuing disabled airplanes that frequently are stranded on mud flats near the Naval Air Station at San Diego, Calif., naval officers invented the ingenious sea sled pictured above.

So shallow is the water above the flats that attempts to use ordinary speed boats to reach stranded planes were abandoned. Approach on foot through the soft mire was out of the question.

The hull of the new sea sled resembles on a large scale the aquaplanes used in water sports. Its draft is only eight inches and therefore it can maneuver in water less than knee deep.

The craft is driven by an airplane engine and propeller mounted at the stern. The pilot's cockpit is immediately in front of the engine. Six men can be carried on this sea sled.

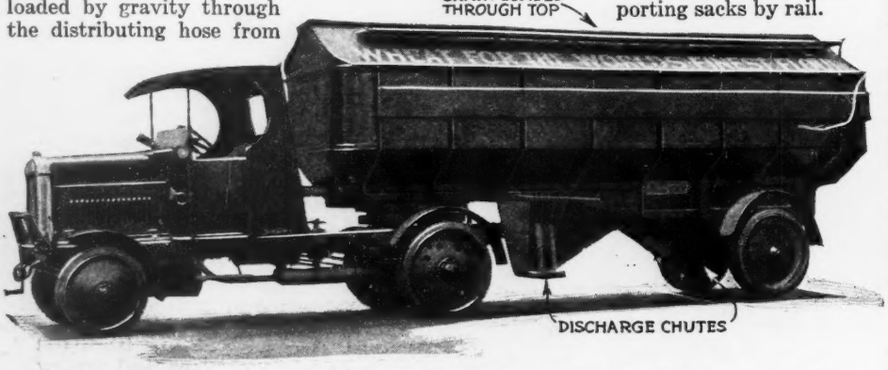
Skimming over the surface of the water, the boat is said to have attained a speed of 29 miles an hour.

HUGE GRAIN TRUCK HAS SIX WHEELS

A SIX-WHEEL motor truck, built by a firm of millers in London, England, has a capacity of 448 bushels of grain—about 13½ tons—yet it can be loaded by one man in half an hour, or unloaded in 20 minutes.

This huge vehicle, which has a body length of approximately 22 feet, averages 60 miles a day in three trips back and forth between a London dockside and the firm's flour mills. It is loaded by gravity through the distributing hose from the granary floor overhead, and is discharged through three chutes beneath it onto an underground conveyor at the mill. The body is constructed with slanting sides to prevent any particles of grain from finding permanent lodgment.

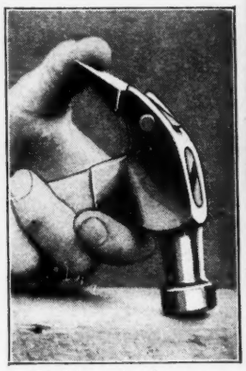
The giant truck has been in operation only a few weeks, but its owners say that already it has effected a considerable saving in labor and transportation as compared with transporting sacks by rail.



The six-wheel grain truck, showing the narrow opening at top through which grain is loaded, and the discharge chutes below. The body is 22 feet long, with a capacity of 448 bushels

Movable Hammer Claws Have Vise-Like Grip

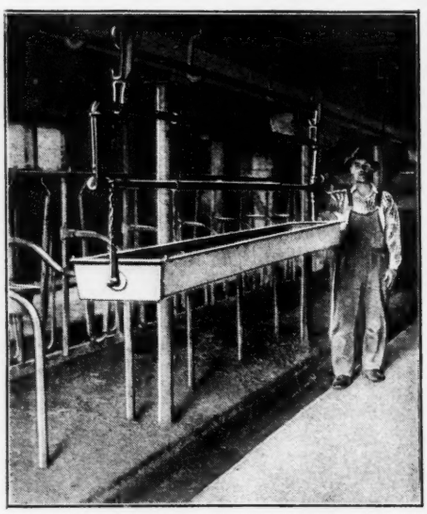
THIS carpenter's hammer, with movable, vise-like claws, capable, it is said, of pulling the most stubborn, headless nail, is the invention of George Ainsley, of Long Beach, Calif.



Pushing the hammer claws spreads them to grasp the nail

In gripping a nail, the claws, pivoted 1½ inch from their ends, spread apart when pushed toward the handle. Then, when they are straightened by a pull on the handle, they are forced into the wedge-shaped opening of the bearing shoulders, tightening the hold on the nail in proportion to the force required to draw it. A spiral spring in the head straightens the claws when the nail is removed.

The jaws, if damaged, may be replaced within a few minutes.



Litter Carrier Saves Time on Dairy Farm

TO LIGHTEN one of the most disagreeable of farm tasks and increase sanitation on his dairy farm, George Benson, of Cambridge, Wis., has invented the movable litter carrier shown above.

Into the gutter of the cow barn fits a series of steel troughlike pans. These are lifted by a chain hoist and carried on an overhead track to the manure pile. There the pan is tripped automatically and dumped.

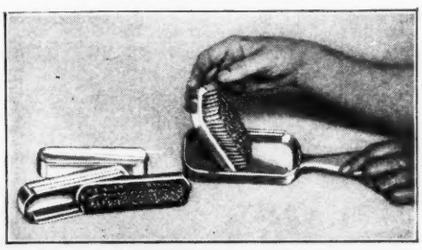
The carrier rod telescopes to four feet, making it adjustable to pans of widely varying lengths. The simplicity of the invention is said to place its cost and its upkeep within reach of even the small dairyman.

It is claimed that the invention accomplishes a saving of one third in time and three fourths in labor, besides assuring greater purity of the milk supply.

Spring Clamp to Prevent Rattling Windows

WINDOWS that rattle in the wind all night are said to be silenced by this newly patented combination sash holder and window lock. The device also makes it more difficult for a burglar to enter.

The sash can be lifted to any position and there securely held by two clamps that press tightly against the window frame. A slight pressure on the handles of the spring catch releases the grip of the clamps.

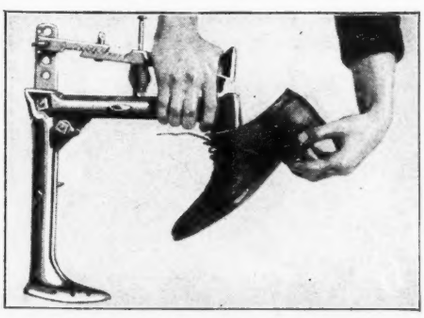


Brush Holder also Serves as Sanitary Cover

A SANITARY metal cover for the household brush is provided in a combination brush holder and case invented by A. H. and D. A. Wolf of Philadelphia, Pa.

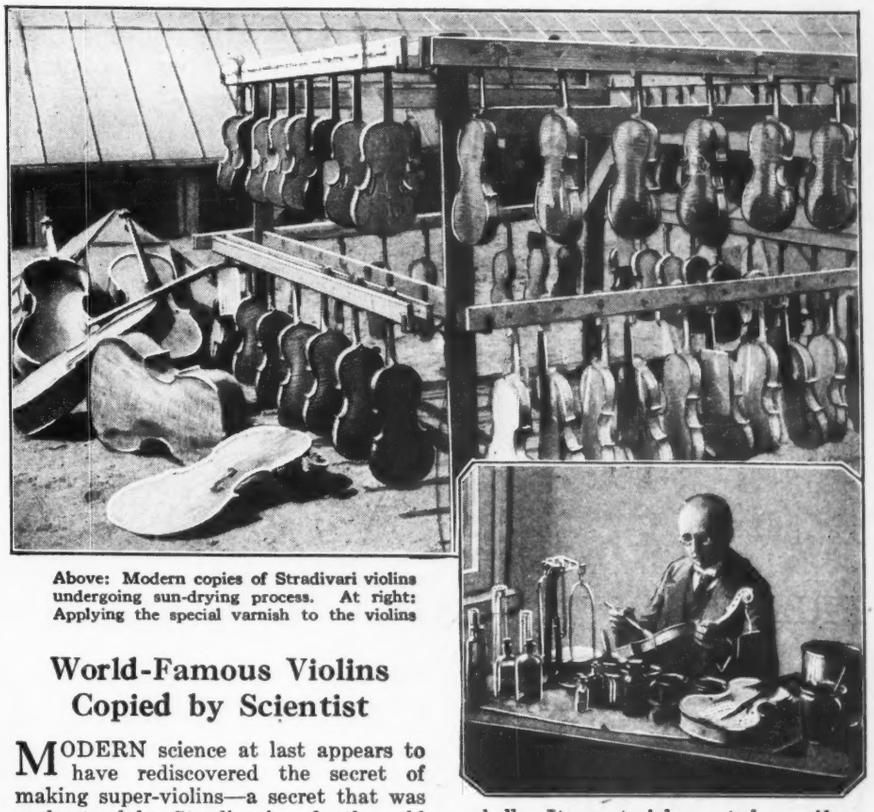
When the brush is not in use, the case, which has one open side, covers the bristles. When the brush is in use, the case serves as a back, the bristles being exposed in the open side. In reversing, the brushes slide on small tracks along the inside edges of the cover.

Adjustable Last Designed to Fit Any Shoe



Fitting the adjustable last to a shoe

THE adjustable shoe last shown here is the invention of Hans Gafner, of Escanaba, Mich. In addition to being adjustable to the length of the shoe, as are many types of last, it is split longitudinally so that it can be compressed or expanded for adjustment to the width of the shoe as well.



Above: Modern copies of Stradivari violins undergoing sun-drying process. At right: Applying the special varnish to the violins

World-Famous Violins Copied by Scientist

MODERN science at last appears to have rediscovered the secret of making super-violins—a secret that was understood by Stradivari and other old masters of the seventeenth century, and that was buried with them.

Professor F. J. Koch, physicist and musician of Dresden, Germany, is reported to have duplicated world-famous Stradivari violins so successfully that in recent tests a group of Italian musicians was unable to distinguish between their tones and the tones of his instruments.

After a searching analysis of thin wood sections from the works of the masters, Professor Koch concluded that the secret of their tone lay in imparting an artificial uniformity to the wood. A violin is like a bell. Its material must be uniform throughout to produce the "deep" tones that are pleasing to the ear. If its wood contains small bubbles, pores or minute cracks, it will produce discordant tones.

Since no wood in its natural state is entirely uniform, Professor Koch set out to rediscover the method of making it so. His clue to the secret lay in a peculiar, transparent substance he found in the pores of the wood from the Italian violins. This discovery finally led to an oil treatment which, combined with months of sun-drying and a special varnish, is said to have produced his remarkable results.

SILK TUBE SERVES AS FIREMEN'S NET

HUMAN bodies shooting to safety through a tube of silk from the upper stories of burning buildings! Such an improvement over the fireman's life net is said to be embodied in a life-saving tube perfected by a Cleveland, Ohio, inventor and successfully tested in that city.

The tube is of balloon silk, incased in heavy netting. The upper end is affixed to a window of the burning building, the lower end held by firemen in the street. The person being rescued enters the tube head first, and slides through it to the street, the speed of the descent being regulated by pulling the tube taut or permitting it to become loose.

The person being rescued shoots head first to safety through the silk tube

EARTHWORMS—though their brains are in their abdomens—have memory and can be trained to go in a specified direction, says Prof. L. Heck of the University of Prague, Germany, after a series of experiments with 500 worms.

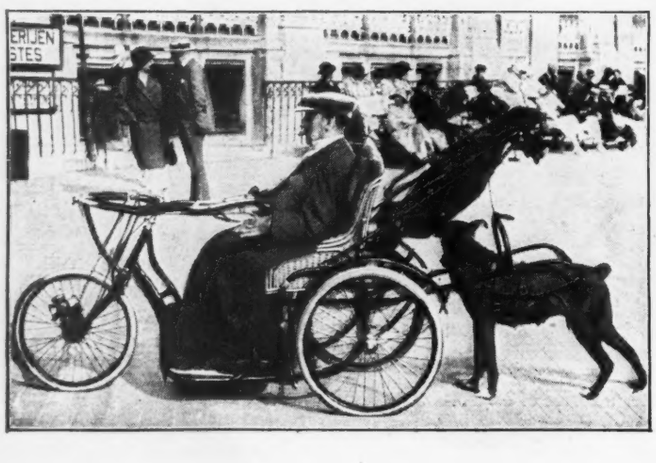
PRIZE COW WALKS ON WOODEN LEG

THIS cow, "Fanny," was the champion milk producer of the whole county in a farming section of Illinois until an injury to one of her legs resulted in an infection which for a time caused her owner to fear it would be necessary to destroy her. A local veterinarian, however, amputated the affected leg, and then supplied "Fanny" with the wooden leg which she is wearing in the picture.

ONE RAM GIVES 25 POUNDS OF WOOL

ONE of the largest clips of wool ever taken from a single animal, 25 pounds, was shorn recently from this ram at Santa Cruz, Calif. The illustration shows the animal just after the shearing was completed. He is a registered Rambouillet of the long hair variety.

WHEEL CHAIR DRIVEN BY DOG MOTOR



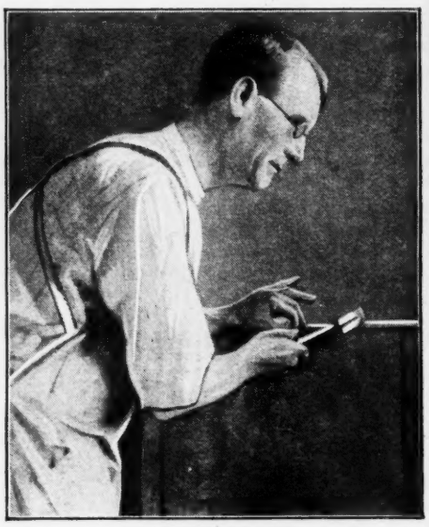
THIS unique dog-powered wheelchair attracted much attention when it appeared recently on the beach walk at Ostend, Belgium.

The photograph seems to indicate that the canine motor neither resented nor suffered under the apparently strenuous task imposed by his crippled master.

This Blind Carpenter Has Built Six Houses

ALTHOUGH totally blind, John Taylor, of Canton, Ohio, is a successful carpenter. For 28 years he has been unable to see the hammer he works with; yet in that time he has built six houses.

His infirmity, dating from his early youth, never has prevented him from hitting a nail squarely and soundly on the head, a feat that is beyond many a man with perfect vision. He now is finishing an addition of six rooms to his home, and is said to have done every piece of the work himself. He even laid an additional length of cement walk for the home that he recently enlarged.



John Taylor, blind carpenter of Canton, Ohio, can hit the nail on the head every time

Bicycle Sidecar Becomes Popular in Germany

THE average pair of legs feels that pedaling two bicycle wheels and a rider is a sufficient task. But in Berlin, Germany, where the cataclysmic collapse of the mark has made street-car rides prohibitive luxuries for thousands, the bicycle sidecar has been born of necessity and is a common sight.

A two-passenger bicycle in Berlin

Better Heat with Less Fuel

By Orion O. Oaks, M.E.

"I BURNED four tons of coal last month in my seven-roomed house and could not keep warm. If I had not used two oilstoves in addition to the furnace, my family actually would have suffered from the cold. I am at my wits' end to know what to do about it."

A Common Problem

In this way a friend of mine recently presented his home-heating problem to me—a problem that confronts more than half the home-owners of the country. An inspection of his hot-water heating system revealed the fact that there was absolutely nothing wrong with it. Even his coalbin was filled with the proper kind of fuel. Imagine his surprise when I demonstrated to him that the trouble lay not at all in his equipment, but entirely in his ignorance of how to take care of his furnace.

His practice had been to go down to the cellar in the morning, open the damper and all the doors of the furnace, then shake the grate until the hot coals fell into the ashpit; finally, to throw in a few shovels of stove coal. Often the fire went out. At other times he could get up no heat until late in the morning.

What he should have done was to shake the grate just once or twice to remove the packed ashes and allow air to pass through. A few shovels of coal then should have been spread over the surface. This would have ignited in a few minutes and started steam. When fully ignited, the firebox should have been *filled* with fresh fuel.

Smothering the Fire

Shaking the grate too much when starting from a banked fire causes the coals to fall together and clog the air passages between the coals, stopping the draft. Since there is little fire in the morning, it cannot break through sufficiently fast. Either the fire suffocates or it takes too long to heat up, especially when large coals are used.

Another difficulty often encountered is due to improper care of the fire during the day. Some persons throw in a few shovels of coal every hour or two in the belief that such a method is economical. As a matter of fact, it actually wastes fuel, causes more work, and decreases furnace efficiency.

After the fire has been well started, the firebox should be filled with fresh fuel until the top layer of coal is halfway between the top and bottom levels of the fire door in the center,

For mild weather

To get better heat with less fuel, keep the firebox full. Don't put on the coal in driblets. The top of the coal should reach the middle of the fire door, as shown above. Insets show how the fire should be regulated for mild and for very cold days

For cold weather

sloping down at the front so that the coal will not fall out when the door is opened.

With such a mound of fresh coal on top and a bed of live coals extending to within about two inches of the fire door, the fire should burn without additional coal for at least eight hours on a severely cold day, and as long as 14 hours on a mild day. During this interval only the grate will require attention.

On a mild day a layer of ashes as deep as six inches may be maintained. This will hinder rapid combustion and supply just enough heat to keep the chill out of the house. On a severe day, however, the ashes should be kept down to a minimum, never allowing more than an inch or two to accumulate before shaking the grate a little. Shaking every three or four hours should be sufficient.

Leave the Damper Open

When shaking, leave the smokepipe damper open, close the check draft and draft door in front of the ashpit. Never poke hard coal fires from above. Shaking the grate will split the surface sufficiently to allow the fresh fuel to fall among the live coals.

For banking at night, shake out the ashes and fill full of coal, then close the damper after allowing a few minutes for free gases to ignite. All this applies equally to steam, hot-water, or hot-air furnaces. In all cases you will find that less coal will be used and more heat obtained by maintaining a deep fire rather than a shallow one.

An important consideration in steam and hot-water systems is to keep the water at the proper levels. In steam boilers usually you will find a gage with a line marking the water level.

Why Gage Is Important

Should water fall below this level, it will lessen the ability to maintain even heat; should it become empty, you may burn out the boiler. Too much water, indicated by a full gage, will allow no room for the steam. If a valve is accidentally left open, all the radiators may become full of water, producing no heat and causing considerable trouble.

In the hot-water heating plants there is a gage indicating the amount of water in the system. A fixed pointer indicates "full," and a movable pointer shows the actual amount. Before starting a fire, be sure that the system is filled.

In hot-air furnaces, where pipes are used, difficulty in heating may be due to the fact that air is not drawn into the system from

In steam and hot-water furnaces it is important to keep the water at the proper levels. Lack of water results in poor circulation and the danger of burning out the boiler. The steam plant, above, should be kept full to the water line. In the hot-water system, at right, the dial pointer should indicate "full"

the outside in sufficient quantity. The intake opening should be located on the side of the house from which the prevailing winter winds blow. If situated on the wrong side, there will be a suction on the inlet instead of a pressure inward. In pipeless systems the cold air from the house drops through the rim of the single register into the furnace. After it is heated there, it ascends through the center of the same register. Outside conditions do not affect this type of heater as they do the piped hot-air system, for the air in the house simply is recirculated.

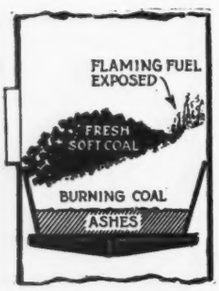
Keep the Air Moist

In both hot-air types water should be kept in the trough located in the side of the furnace. This will allow the air to absorb moisture to keep the house atmosphere at a healthful humidity.

In all systems the furnace and pipes should be kept clear of soot and dirt. In hot-air furnaces there is a door in front of the radiator through which the dirt can be scraped. A coat of soot will prevent the heat from penetrating to the heating units, whether they contain water, steam, or air. A good practice is to inspect the pipes at least twice a month. You will find that a few minutes' work will clean out the soot deposits.

Clean soot and dirt from boiler flues of steam or hot-water furnace at least twice a month, using a scraper as shown above. Ashes should be removed from the pit every day. If they are allowed to accumulate until the pit is full or until they touch the grates, as shown at the right, they not only will cut off the draft, but may eventually succeed in burning out the grate

To keep the furnace working properly and to prevent burning out the grate, the ashes should be removed daily. If the ashes are allowed to accumulate so that the pit is full up to the grate, the heat not only will cut off the draft, but sometimes will buckle the grate bars.



How to burn soft coal: Pile the fresh coal in front, allowing the burning coal to be exposed at the rear

Very often all the most perplexing of your furnace troubles may lie in poor draft. Chimney corners filled with soot, clogged smoke pipes, or a chimney of too small a cross section may be the cause. In any chimney not only strength of draft but quantity of draft is necessary. For that reason it is best to have the necessary chimney area computed by a competent authority rather than to rely on guesswork.

How to Control the Draft

When a freely burning fire is necessary, the smoke damper should be open, the slide on the fire door closed, and the draft door open. Checking of the draft should be controlled by the damper, allowing just enough draft to supply the proper amount of heat. In the intake pipe of hot-air systems there is a damper to control the amount of air admitted to the furnace plates. Obviously if this damper is tightly closed, the circulation of hot air is impeded. If the hot-air system is not working properly, regulate the intake damper until you get the desired amount of heat in the rooms.

Another question that arises is the kind of fuel to use. For ordinary house-heating plants the most satisfactory is stove coal. Other fuel, of course, can be burned efficiently after some practice. Coke alone may prove difficult, but if properly handled will produce satisfactory results. Large stove coals are hard to use when starting a fire. Buckwheat is small and lies too compactly when burned alone. It may be well to have a special bin of small fuel for starting the fire the first thing in the morning.

The use of soft coal involves a problem of its own. In some cities it is not permitted because of the tendency to produce smoke, although special boilers have been designed to eliminate this nuisance to some extent.

When burning soft coal be sure not to cover the entire live-coal surface with fresh fuel. Either it will put out the fire, or it may cause an explosion. This is because a large amount of combustible gases are formed and do not burn at once, since the small particles of soft coal pack the surface tightly. After a while the fire may break through, ignite the accumulated gases, and blow the fire door off its hinges. Always put the fresh soft coal in front, leaving the glowing coals on top in the rear.

Air in the Pipes

Even if the furnace is working perfectly and you are taking proper care of the fire, you still may have difficulty in keeping the house warm. In a steam system air accumulates in the pipes overnight and must be driven out by the steam before the radiators can become hot. For this purpose the radiators are fitted with air valves. If these are not working properly it may be very difficult to heat the house, even though there is plenty of steam in the boiler. A vent valve fitted on the end of the steam main of such a system may help in allowing a considerable amount of air to escape.

Radiators Must Be Adequate

Likewise, in steam and hot-water systems the amount of radiating surface may be insufficient in some or all the rooms; or in hot-air heaters the cross section of the registers may not be great enough to supply an adequate quantity of fresh heated air. If you have any reason to suspect that these are inadequate, call on an expert to compute these values for you.

No matter how well you look after the fire, no matter how much coal you burn, you cannot expect to heat your home if any part of the apparatus is too small for its needs.

In every type of heating system the smoke pipe should be disconnected from the flue at the end of the season and all soot should be cleaned out. All doors on the furnace should be left open and the hinges thoroughly greased. In the case of steam or hot-water plants, water should be left in the system.

If you have cleaned and taken care of the system at the end of a season in the manner described, you will only have to spend a few minutes to get it started in the fall, and it should give good service throughout the winter.

A typical hot-air furnace. Methods of firing are the same as for steam and hot-water types. Clean soot and dirt from the radiator once a month through the "clean-out" door at the top. The inset shows water trough, which should be kept full of water to maintain a healthful humidity

Mechanical Aids for the Kitchen

IN THE completeness of its labor - saving mechanical equipment, the modern American home is keeping pace with our most efficient factories. On this page are pictured some of the latest devices to free the housewife of burdensome drudgery.

Spring jaws attached to a small device for the wall or door serve as a convenient towel holder, providing quick release for a towel when needed. Pulling downward spreads the jaws and releases the towel for use

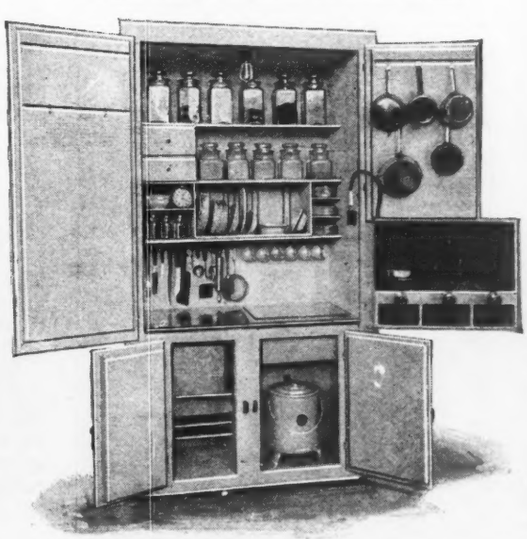
This electrical "mechanical servant" mixes, beats, whips, mashes, chops, slices, strains, and in addition serves as an ice-cream freezer. The insert at the left shows the attachment for beating eggs or batters and making mayonnaise. At the right is the meat-grinding attachment. Above the machine is being used as an ice-cream freezer

Inserting this aluminum cylinder, perforated at the bottom, and pressing a finger over a tube at the top, quickly draws off the cream from the top of a milk bottle

The chance that the milk can, with its dust - covered clots of milk around the pouring holes, may become unsanitary is eliminated by this simple can puncturer that slips into the holes it has punched

The usual difficulty of cleaning thermos bottles or jars is said to have been remedied in this new type hot or cold container. The glass jar is quickly removable for cleaning after use

Jelly making has been simplified by this simple metal frame with adjustable supports that hold the strainer bag securely in place



An entire kitchenette in a small cabinet. It contains an electric stove, a sink with hot and cold water, icebox, garbage pail, cooking utensils, kitchen cutlery, glass containers, shelves, compartments, bread boxes, and drawers

This novel pie-crust trimmer cuts off the overhanging crust and tightly seals the upper and lower crusts by a pronged wheel

MAGNET AIDS PIANO BROADCASTING

PIANO solos always have been one of the least effective features of broadcast programs because, although the abrupt sounds from the hammer blows are transmitted distinctly, the relatively weak singing quality and the overtones fail to reproduce satisfactorily. The General Electric Company now claims to have overcome this defect by a new magnetic system. The magnet is fastened firmly to the frame of the piano and a coil is anchored to the sounding board. This combination is said to reproduce faithfully the finer tone vibrations.

Pencil Radio Set Uses Crystal Detector

THE ingenuity with which midget radio receiving sets are made parts of other articles in common use appears limitless. One of the latest of these novelties is this pencil receiving set combined with a pair of head phones. It is a complete radio crystal set and can be carried easily in a pocket or purse.

A small tuning coil is wound around the pencil, and the crystal fits into the cup where usually the eraser is. A piece of wire acts as a catwhisker. The set obviously is not selective, but it is said to work over a range of from 10 to 20 miles quite satisfactorily.

The set is said to be especially useful for taking notes on broadcast lectures, speeches, or sermons.

Solid Auto Wheel Used as Radio Aerial

A SOLID automobile wheel proved to be an effective aerial when Miss Genevieve Keane, New York radio enthusiast, tried the experiment with her one-tube reflex set. It developed that the wheel gave best results when turned in the direction of the broadcasting station—just like a loop aerial. The steering wheel thus became a sort of tuning dial. Wire wound around the spokes of the usual type wheel also is said to have given successful results.

Miss Genevieve Keane, of New York City, using a solid auto wheel as an aerial

Amateur Radio Stations Increase Steadily

WHILE the popularity of radio broadcasting, after a spectacular development since the winter of 1921, apparently reached its pinnacle last year, amateur radio transmission is continuing the steady advance that has marked its development since its official recognition by the United States government in 1912.

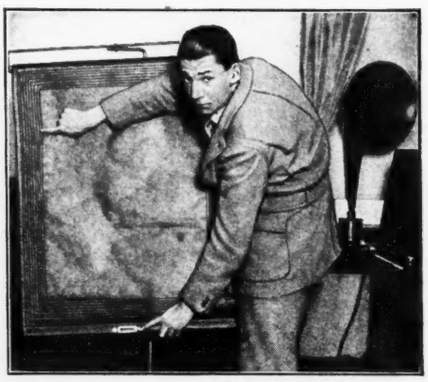
Such is the conclusion drawn from figures recently compiled by W. D. Terrell, chief government supervisor of radio at Washington, D. C.

These figures reveal that in the last 10 years the number of amateur sending stations has increased from 1224 to 16,570. They also show that the number of broadcasting stations has fallen off during the last year. In September, 1923, there were 563 broadcast stations as compared with 591 in the month of May, regarded as the saturation point. Meanwhile, the number of amateur sending stations has been advancing steadily and now is at its highest peak.

Although amateur radio transmission dates away back to the late '90's and almost has been lost sight of in the wave of interest in the reception of broadcast entertainment, amateur enthusiasm never has waned.

This undiminishing enthusiasm is due in large measure to the tremendous expansion of popular radio.

Window Shade Serves as Indoor Loop Aerial



A WINDOW shade that also serves as an indoor loop aerial has been devised by W. H. Bullock, a New York radio engineer. The material used is the same as that in ordinary window shades. The wires of the aerial are sewed in around the edges, as indicated by the right hand finger of the man shown above.

The aerial is connected with the set at the connections shown on the bottom of the shade. The invention can be hung on any window, the wires being inconspicuous. Tuning is accomplished by pulling the shade up or down.

AFTER wiring a radio set, go over it carefully. Wherever the wires are close together, reroute them so as to separate them as much as possible. It is better to have the wires a little longer than to have them running close to each other.

A King of Radio Sets

Secrets of the Super-Heterodyne—the World's Most Sensitive Receiver

The newest type of eight-tube super-heterodyne receiver perfected by the Radio Club of America, and George E. Burghard, president of the club. Note that the set has only two controls — for wave lengths and for frequency changes

By Jack Binns

America's Foremost Writer on Radio

IS THERE any radio receiver that will reproduce programs broadcast from coast to coast? The answer is—Yes! It is the super-heterodyne receiver—the Rolls-Royce of radio—invented by Major E. H. Armstrong, of regenerative fame, to meet an imperative condition during the war.

I can say without qualification that it is the most sensitive and the most selective radio receiving apparatus known to man.

Simplifying the Super-Heterodyne

The chief difficulties in the past that have prevented the popular adoption of the super-heterodyne in the reception of broadcast programs have been the large number of tubes necessary to operate it, and the fact that it required an expert to manipulate its variable parts. The advent of a really "hard" vacuum tube with low filament consumption now has solved the former problem, while the splendid work done by members of the Radio Club of America under the supervision of Major Armstrong has simplified the latter.

When the super-heterodyne circuit was invented, no efficient radio frequency amplifying transformer had been produced. Experience up to that time showed that while it was possible to amplify radio currents at the frequencies involved in fairly long wave lengths, the question of capacity was too difficult to solve when it came to the terrific frequencies that prevail on the short waves. The amplification of radio waves had been accomplished by resistance coupled stages, which, while not very efficient, answered the purpose if the waves were long ones.

The problem that confronted Major Armstrong was to design an instrument that would detect the extremely short waves used in trench wireless, upon extremely low power. These waves, of course, involved frequencies far too high to amplify by means of resistance coupling.

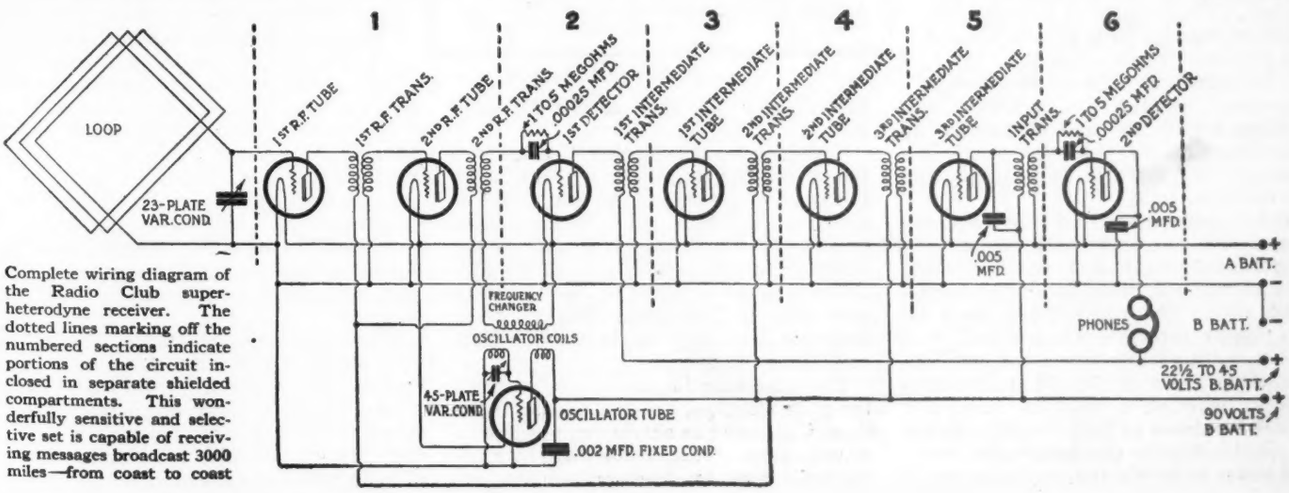
Armstrong knew that it would be a simple matter to amplify the short waves if the frequencies could be reduced to correspond with those of the long waves. He came to the conclusion that if he were to set up a series of local waves with an oscillator, he could produce any frequency he desired by varying the constants of the inductances and capacities of the oscillator. He decided, for example, that if he were to impress on the detector tube a wave from the oscillator, having a frequency difference of 50,000 cycles from the incoming wave, he would get a frequency output of the same value from the detector.

A Double Detector Receiver

Now 50,000 cycles frequency represents a wave length of 6000 meters, and is readily amplified by the regular cascade system. Three stages of such amplification, he reasoned, would bring the signal up to a point where it could be rectified to work the telephones. This conclusion was borne out absolutely in practice.

The principle of superimposing another frequency on the first detector is known as "heterodyning." Because the incoming waves are detected and heterodyned before they are passed through the amplifiers for rectification, the super-heterodyne system also is known as the "double detector receiver."

Since the original model of super-heterodyne was produced, radio frequency transformers have been developed. Now a transformer designed to operate most efficiently at a frequency of 50,000 cycles a second will allow only that frequency to



Complete wiring diagram of the Radio Club super-heterodyne receiver. The dotted lines marking off the numbered sections indicate portions of the circuit inclosed in separate shielded compartments. This wonderfully sensitive and selective set is capable of receiving messages broadcast 3000 miles—from coast to coast

pass through it, provided it is operating correctly.

It is this very fact that makes the super-heterodyne so selective. Whatever may be the wave length of the station we desire to listen to, there is only one point where this wave length will give a beat note of 50,000 cycles when it is passed through the first detector and subjected to the clashing frequency of the oscillator. This is because there is only one point in the setting of the oscillator where the difference of 50,000 cycles appears.

Two Controls Suffice

The beat note of 50,000 cycles, which is the product of the first detector tube, faithfully carries with it the modulation of the incoming wave, so that a perfect reproduction of speech, music, or dots and dashes is reproduced by the second detector.

The latest type of super-heterodyne receiver embodying the simplifications made by the Radio Club of America and used as the official receiving apparatus for the recent radio show in New York City, has but two controls—one to adjust the set to the incoming wave length, and the other to change the frequency of the oscillator. Since hard tubes are used throughout, it is necessary to use only one rheostat to control all of them.

The new model employs eight tubes without any audio frequency amplification. It is novel in that two stages of transformer-coupled radio frequency amplification are used to strengthen the currents picked up by the loop aerial before they are passed through the first detector. This results in an ultra-sensitive receiver, one which is readily capable of receiving Pacific Coast broadcasting stations at the Atlantic seaboard.

The secret of the wonderful selectivity of the improved super-heterodyne lies in the special transformers designed to amplify at 50,000 cycles.

Applying Variation Frequency

The first part of the Radio Club receiver consists of two stages of transformer-coupled radio-frequency amplifiers. Their range is between 200 and 600 meters, with a peak around the broadcasting wave lengths.

The output from these two stages is impressed on the first detector tube through a grid leak and condenser. In this input circuit, however, there is a "pick-up coil," which is coupled with the oscillator coils.

In this manner the variation frequency is applied to the first detector tube.

Satisfactory coupling can be made through the use of duolateral or honeycomb coils. The grid coil may be a 35-turn, and the plate a 25-turn coil. The pick-up or frequency change coil may consist of 30 turns of No. 36 double silk-covered wire on a one-inch tube, and should be placed so that it can be varied in relationship to the honeycomb coils, just as the rotor of a 180-degree coupler is varied with respect to the primary winding. Once set, however, the position of the pick-up coil may be left alone, and the frequency change made entirely with the variable condenser across the grid coil, as shown in the diagram on page 59.

After we reach the first detector, it is absolutely necessary that every stage should be carefully shielded. The top, bottom, and side of each separate stage should be inclosed in a copper box.

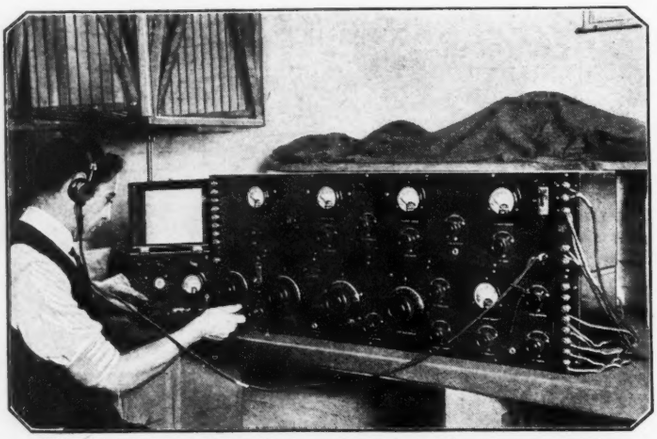
Since the detector tube and its intermediate frequency transformer may be inclosed together in one section of the shield, a short direct lead may be made from the plate terminal of the tube socket to the primary of the transformer. All the filament and B battery leads may be taken from the rear of the shielding box.

This leaves but one connection to go to the succeeding stage—the grid lead from the transformer secondary to the grid of the succeeding tube. This lead should be passed directly through the wall of the shield, through a small hole, slightly larger than the diameter of the connecting wire with its insulation. Naturally the lead should be kept as short as physical conditions will permit.

The first transformer connected with the plate circuit of the first detector tube should be tuned as sharply as possible to 50,000 cycles. This can be done by joining fixed condensers across both the primary and secondary binding posts. The size of these condensers will be determined, of course, by the transformers.

Since the winding of transformers is somewhat difficult, the builder of a super-heterodyne can employ a standard type of long-wave radio-frequency transformer. This is resonant around 50,000 cycles, and answers the purpose excellently.

Connections of the three stages that amplify the output of the first detector are similar to those for the standard short-wave radio-frequency amplifiers, except for the shielding feature.



This 14-tube super-heterodyne receiver, designed and operated by Claude Golden in New York City, hears European and Pacific Coast stations with ease, using the loop aerial shown at the upper left

Special Transformer Used

When we come to the output of the final stage of this intermediate portion of the receiver, a special transformer must be employed ahead of the second detector. In this connection George Eltz, Jr., a member of the Radio Club of America, who has done much work on the super-heterodyne, recommends the following, where intermediate transformers are used:

The primary of the special transformer should be wound on a bobbin three inches wide, with a center one inch thick, and a space of one quarter of an inch between the sides. The wire is wound just as on a cotton bobbin, except that the winding space will be only a quarter of an inch wide. The primary should have 200 turns of No. 29 double silk-covered wire. Directly over this is wound the secondary, which should consist of 1500 turns of No. 36 double silk-covered wire. In winding these coils, no particular care is necessary; in fact, they can be put on just like cotton on a bobbin.

How Resonance Is Gained

In the circuit the primary is shunted by a fixed mica condenser of .0075-mfd. capacity, to make the transformer resonant to the best frequency of the long-wave radio-frequency transformers. The secondary of the transformer is placed across the grid and filament of the second detector tube.

If an audio frequency amplifier is added to the receiver, a fixed condenser of .005-mfd. capacity should be used across the plate and filament terminals of the detector tube. This will prevent any of the intermediate frequency current from entering the audio amplifiers.

For those who do not know just how to get the correct value of the fixed condensers named above, I may add that the trick can be done by adding fixed condensers of .0025-mfd. capacity in parallel with each other. Three such condensers will have a total capacity of .0075 mfd., and two of them in parallel will give .005 mfd.

When properly constructed, the set is very simple to operate, since only two controls are required. Construction of a set of this type, however, should not be attempted by any radio fan who has not first experimented with the simpler types of radio receiving apparatus.

What's Your Trouble?

DOES your radio set continue to make peculiar noises, in spite of all you can do?

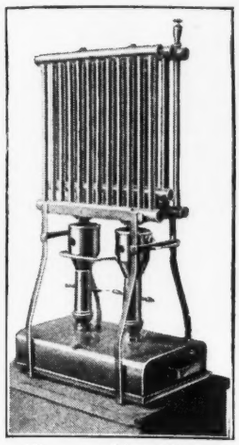
Do you fail to get the results, in clearness of reception, that you think your set should give?

Don't miss Jack Binns' article in next month's issue. This famous authority on radio will explain effective remedies for the most common radio troubles. And for the radio fan who is building his own set, he will suggest valuable precautions against future difficulties.

Portable Steam Radiator Heated by Gasoline

A PORTABLE radiator that supplies steam heat without coal has been perfected for use in isolated rooms, rooms that are difficult to heat adequately, and for small apartments.

Two burners, fed from a tank of gasoline below them, heat the air in a special chamber.



The portable radiator

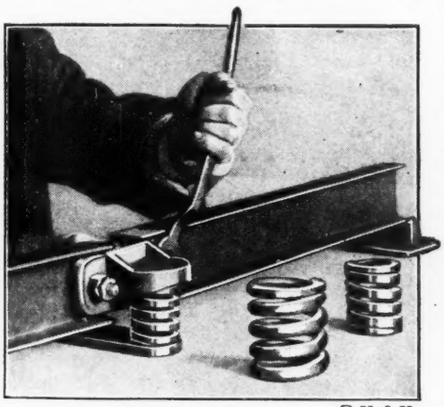
The hot air in turn boils the water in the tubular chambers.

The resulting steam circulates through a system of copper tubes that radiate the heat.

The device is said to be odorless. It holds fuel and water enough to last a week, it is claimed by the manufacturer.

Famous Dance Floor Is Supported by Springs

ONCE in a decade workmen with wrenches "tune up" the famous dance floor of the grand ballroom at the Hotel Savoy, in London. This remarkable floor rests upon steel girders supported by powerful coil springs that impart resiliency to the dancing surface. The floor is designed to bear a weight of 250 tons.



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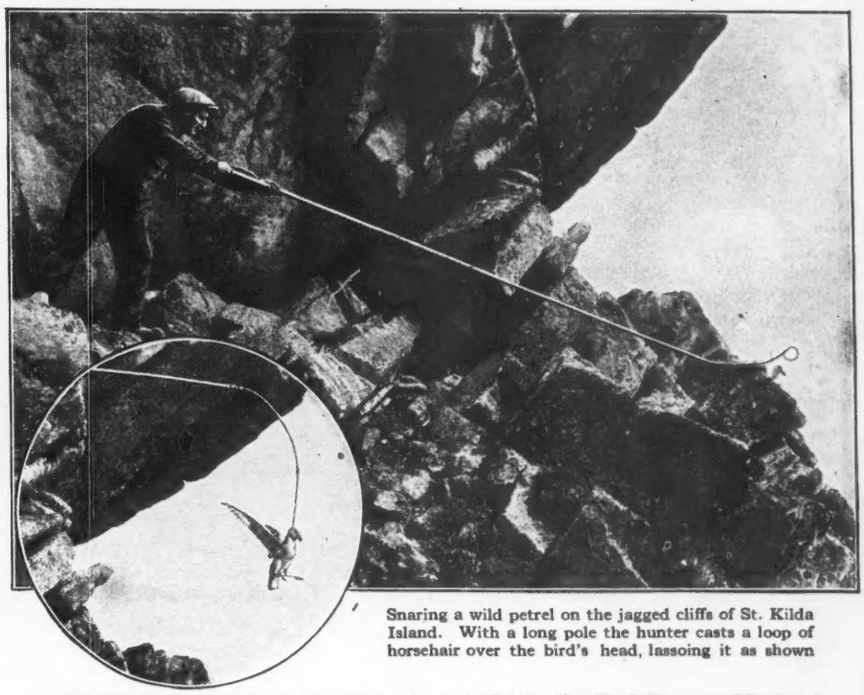
The end of one of the steel dance-floor girders with coil spring attached

The "tuning up" process includes overhauling the springs and girders, as well as refitting and polishing the boards of the dance floor.

Lightning as a Weapon

"IN SOME future war our scientists may be able to hurl a devastating bolt of lightning across the ocean."

Such was the recent statement of Robert Sibley, former vice president of the American Institute of Electrical Engineers, discussing an announcement by Professor Harris J. Ryan of Stanford University that "control to some extent" of man-made lightning is possible.



Snaring a wild petrel on the jagged cliffs of St. Kilda Island. With a long pole the hunter casts a loop of horsehair over the bird's head, lassoing it as shown

WHERE HUNTERS "FISH" FOR BIRDS

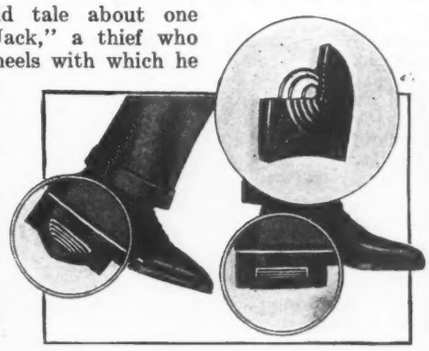
THROUGH centuries of rugged environment the hardy natives of St. Kilda's, a partly barren island of the Hebrides, Scotland, have learned unusual ways of wresting food from Nature. Their method of snaring wild fowl requires careful stalking and astonishing dexterity.

The photograph shows a hunter snaring a young petrel—a bird that is regarded as a particular delicacy. A loop of horsehair at the end of a long, slender pole is flung deftly over the bird's head, and a quick jerk traps the game.

The almost inaccessible ledges on which the birds are found increase the hazards of hunting them.

SPRING HEELS TO "BOOST" WALKERS

THERE is an old tale about one "Spring-heeled Jack," a thief who contrived a pair of heels with which he was able to travel in 15-foot jumps.



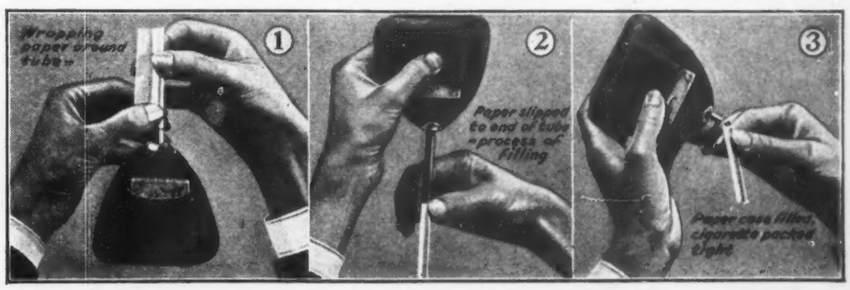
Perhaps the inventor of the spring-heel here illustrated found his inspiration in that old tale. The device consists of an ordinary rubber heel with a cavity on the shoe side in which is fixed a strong steel spring. In walking action the wearer is supposed to compress this spring at the beginning of the step. As the step is completed the spring is expected to assist him. It is claimed also that the spring action supplements the resilient rubber heel for walking.

TOBACCO POUCH "ROLLS YOUR OWN"

A TOBACCO pouch designed to roll a cigarette or fill a pipe without spilling a grain, is a recent addition to the conveniences offered smokers.

A pipe is filled through a tube attached to the pouch. In making a cigarette, the paper is rolled about the tube and the exposed end is closed. Then, with the pouch upside down, the paper is slipped down near the end of the tube, where it is held firmly. Next, the tube is worked gently in and out of the pouch until the paper case is filled. Finally, the tube is pushed all the way into the pouch.

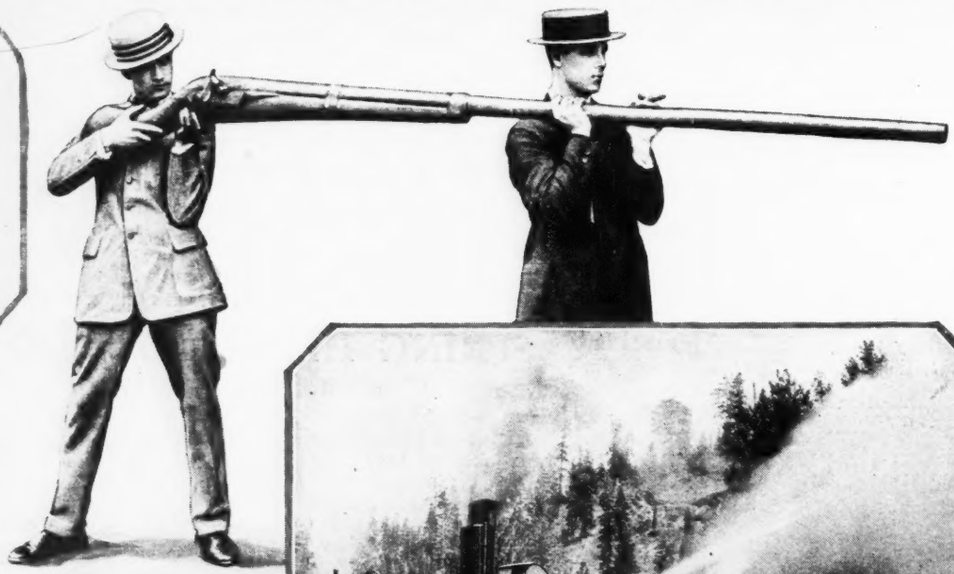
The rubber-surfaced leather substitute of which the pouch is made is claimed to keep tobacco moist. The pouch holds enough for 30 cigarettes.



THE MINUTE HAND OF THE WORLD'S LARGEST CLOCK is so huge that 17 men were required to carry it to a position where it could be hoisted to its dial on the roof of a building in Jersey City, N. J. The hand is 20 feet, eight inches long

A BAROMETER CLOCK

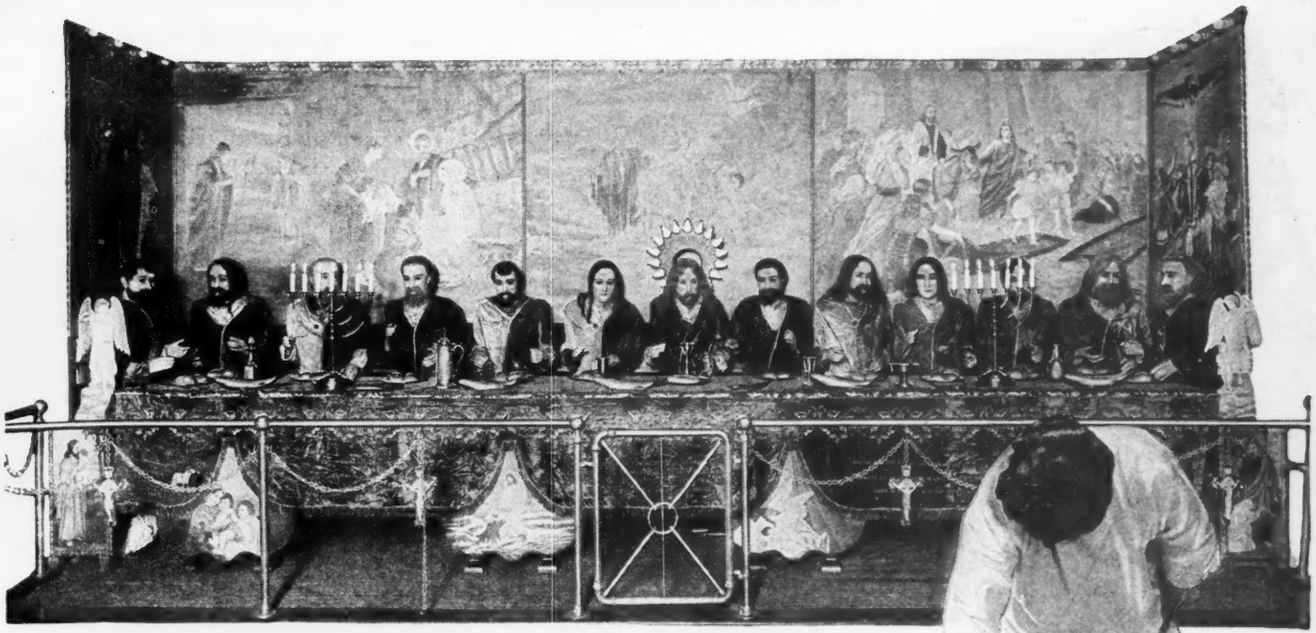
This giant barometer with dial face, on the tower of the German Museum at Munich, Germany, is said to be the only one of its kind in the world. A single hand chronicles the slightest variations in atmospheric pressure, indicating probable changes in the prevailing weather



A SHOTGUN NINE FEET LONG, recently captured by game wardens on the Potomac, Washington, D. C. Mounted on the bow of a motor boat, it is said to have killed as many as 500 ducks at one time. It weighs 150 pounds

THIS LOCOMOTIVE FIRE DEPARTMENT is maintained by the Southern Pacific Railway in California to protect small mountain towns along its line that are endangered by the devastating forest fires. Sufficient water is carried to throw out two powerful streams on a fire for an hour

A BOAT LIKE A FROG, shown at the left, as much at home on land as it is in water, motors through the streets of Scarborough, an English seaside resort, picking up passengers. Then it puts to sea for a spin over the waves. The craft is driven by an auto engine geared to the propeller when the boat is in the water, and to the wheels when it is on land, which makes it amphibious



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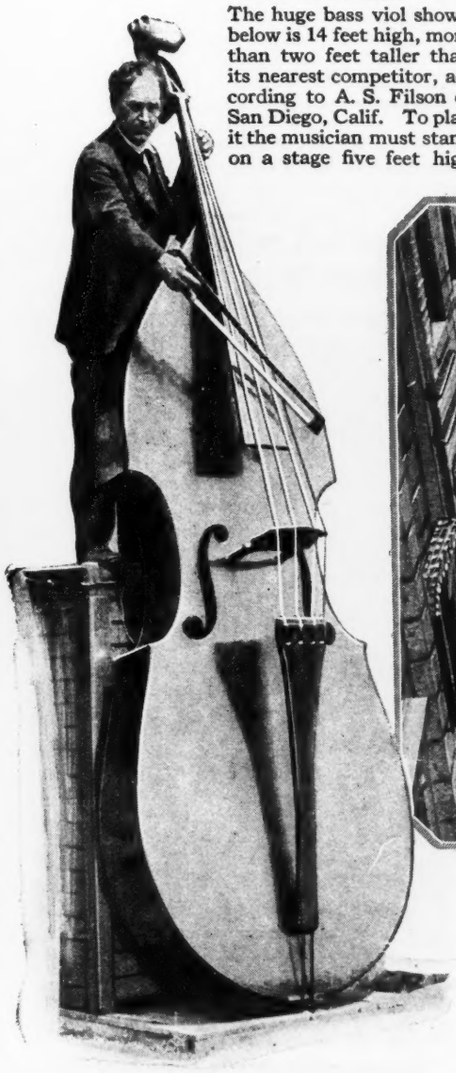
THIS REMARKABLE AUTOMATON DISPLAY, reproducing in lifelike form the Last Supper of Christ and His Twelve Disciples, is the product of 40 years of painstaking labor by an obscure Ohio locksmith. It was purchased recently by John Scharding of Chicago, Ill. The 13 figures are in life size and are controlled by intricate mechanism that moves their arms and bodies and changes their facial expression. The machinery is said to weigh more than 2½ tons

THE LARGEST VIOL

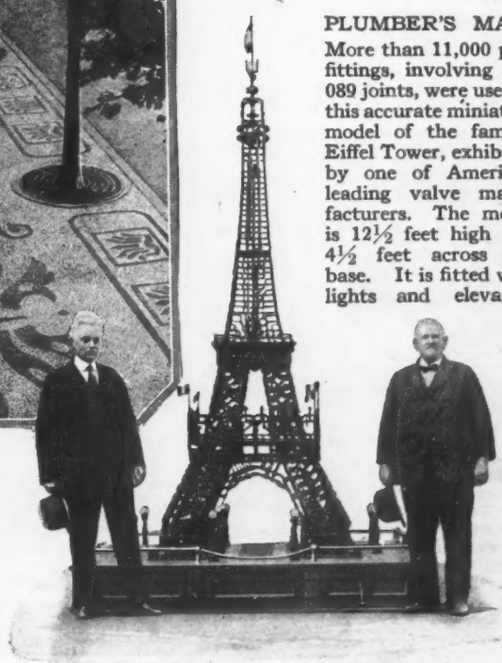
The huge bass viol shown below is 14 feet high, more than two feet taller than its nearest competitor, according to A. S. Filson of San Diego, Calif. To play it the musician must stand on a stage five feet high



DOG ON WHEELS

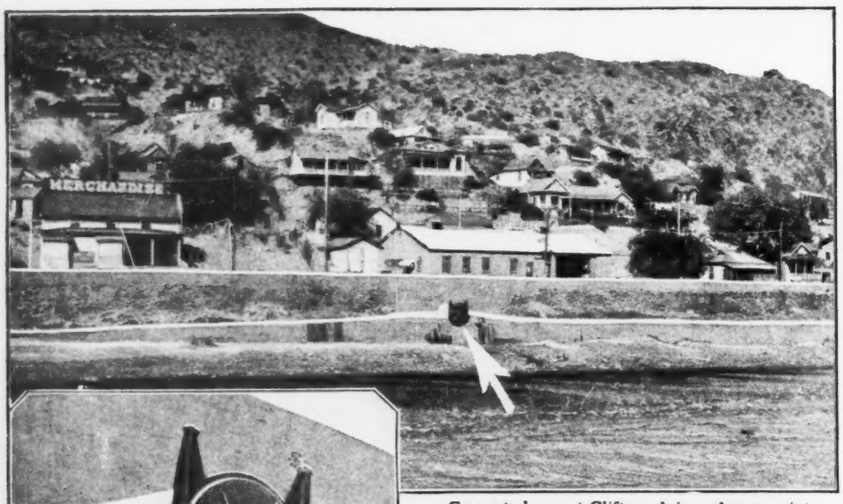
When an irritable cow kicked Peggy, a pedigreed bulldog of Butte, Mont., crushing her backbone, her owner devised this ingenious wheeled support. Now Peggy ranges her old haunts, followed by her puppies

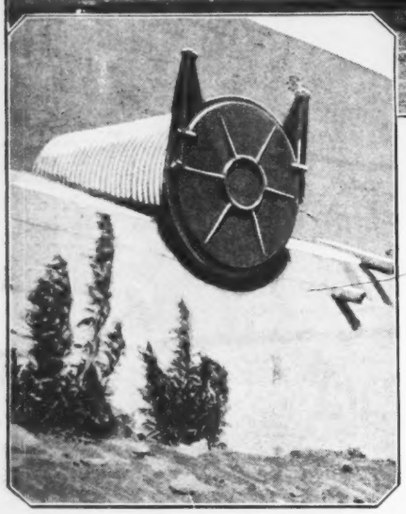
MOSAIC SIDEWALKS line the principal boulevard of Rio de Janeiro, the South American "City Beautiful." The walks, about 25 feet wide, are surfaced with little black and white stones about an inch square, laid in varied designs



PLUMBER'S MAST

More than 11,000 pipe fittings, involving 14,089 joints, were used in this accurate miniature model of the famous Eiffel Tower, exhibited by one of America's leading valve manufacturers. The model is 12½ feet high and 4½ feet across the base. It is fitted with lights and elevators





Concrete levee at Clifton, Ariz. Arrow points to one of the storm drains, shown at left

Drains and Flood Gates Protect Arizona Town

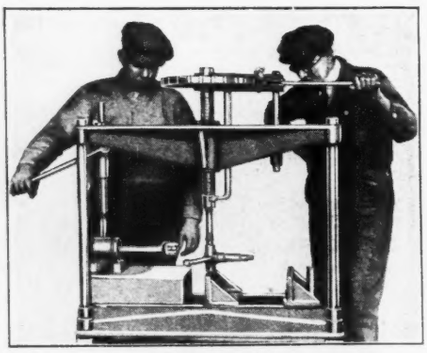
SITUATED in a narrow valley and divided in two by a river, the town of Clifton, Ariz., is in constant danger of being inundated by swollen waters of the river during heavy rains.

For protection, corrugated iron storm drains are provided to carry off the surface water, these emptying through a concrete and masonry levee. As a further precaution against unusually high waters, the drains are equipped with 48-inch cast-iron gates that close automatically whenever the river rises to their height.

Double Arbor Press for Automobile Work

A NEW arbor press, especially designed for motor-car repair work, combines two separate presses for large and small work. The main press is operated by a wheel to which additional pressure can be given by a lever and ratchet device.

A smaller rack and pinion press at the left of the main screw is said to be of great value in wristpin, bearing, and bushing work.



Large and small presses in one machine

New Transatlantic Cables from U. S. to London

THE first transatlantic cable to be laid since 1910 started recently from Far Rockaway, N. Y., on its long journey.

More than 4,000,000,000 pounds of copper were required for its conductor and nearly 2,000,000 pounds of gutta percha for its insulation. More than 80,000 miles of steel and iron wires were wrapped spirally about the cable as a protection. In shallow water, where the danger of injury is greatest, the unusual protection necessary makes it weigh 20 tons a mile. In midocean it weighs only two tons a mile.

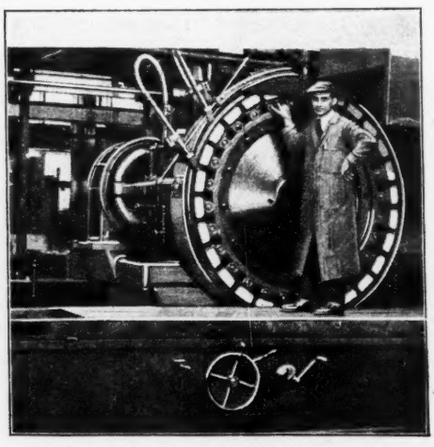
From Far Rockaway the cable will be routed to Canso, Nova Scotia, from there to the Azores, and thence to London *via* Waterville, Ireland.

Starting the cable at Far Rockaway, N. Y.

World's Largest Grinding Wheel Weighs 20 Tons

A GRINDING wheel with a 66-inch face, said to be the largest in the world, has just been completed by a machine manufacturing company of Providence, R. I., for such work as grinding boiler sections having a height as great as five feet.

The abrasive wheel is constructed in 22 sections. Driving power is supplied by a motor of 75 horsepower, the wheel spindle attaining a speed of 180 revolutions a minute. The machine weighs 40,000 pounds.

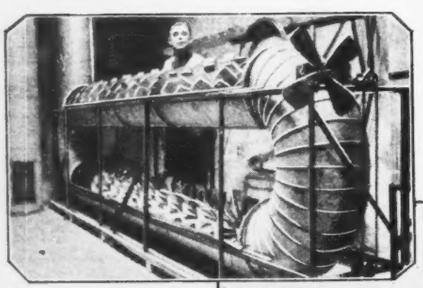


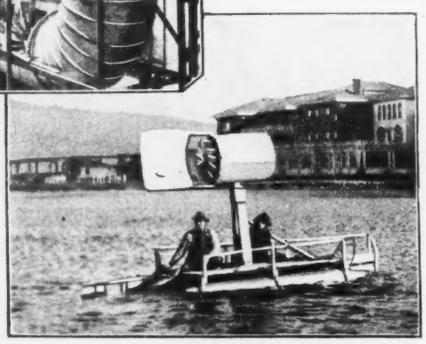
The huge wheel, showing abrasive sections

CLAIMS AIR MOTOR BUCKS THE WIND

AN AIR motor, which its inventor claims will move a boat or vehicle directly against the wind and will virtually manufacture its own wind when no air is stirring, has been developed by Charles R. Ford, of Elma, Wash.

The contrivance consists of a series of fans, or windmills, mounted on the same shaft and inclosed in a cylinder. Between the fans are stationary pieces of metal, which the inventor calls "air straighteners" and which he says so distribute the currents passing through the housing that each fan generates the same amount of power.

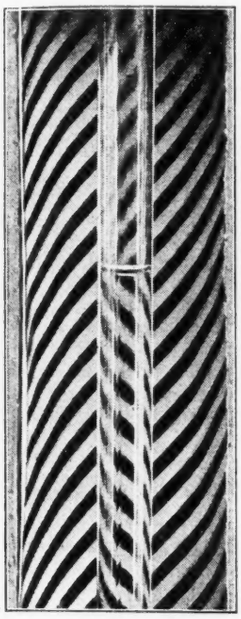




Above: Thirty-blade air motor, invented by Charles R. Ford. The housing is removed to show arrangement of windmill wheels. At right: The invention driving a small raft by wind power

Striped Boiler Gage to Prevent Explosion

MANY a boiler explosion has resulted from the fact that the fireman believed his boiler gage glass was full when in fact it was empty. To prevent this hazard there has been perfected a striped background for gage glasses that reveals at a glance whether the boilers are full or empty.



The lines as seen through the water in the glass are at right angles to those of the background, and the lines through the empty section of the glass are approximately at the same angle as those on the background.

The scheme was first developed for use in the Edison Lamp Works at Newark, N. J., where the interior of the fireroom is white.

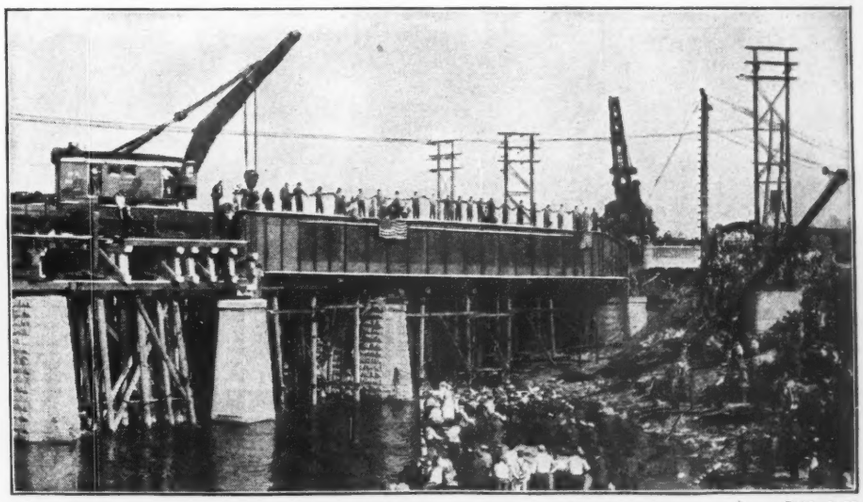
New Camera "Gun" Serves as Important Weapon

THE camera gun for photographing both movies and stills has attained a military dignity nearly equal to that of the most powerful war weapons. Both kinds of photographs are used extensively in determining the effect of smoke screens, shell fire, and aerial bombs, and for estimating the velocity of projectiles.

Chief photographer J. M. Hayme, of the U. S. S. *Wright*, is shown above with his odd looking navy model K-1 aerial camera, taking "movies" from a torpedo plane. This remarkable camera has a special 24-inch lens.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue of POPULAR SCIENCE MONTHLY.

THE WORLD'S LARGEST BRIDGE GIRDER

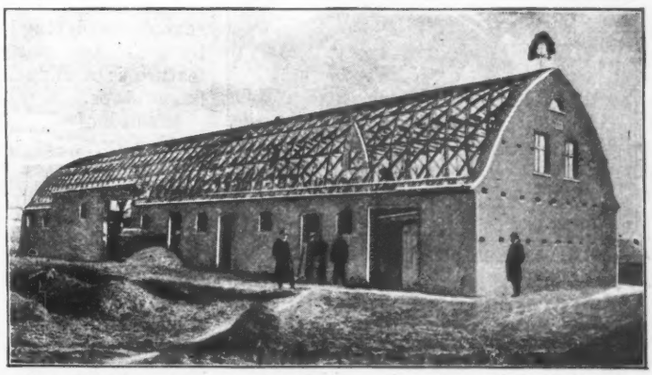


© U. & U.

WHILE motion-picture cameras clicked and hundreds of spectators cheered, the longest and heaviest steel bridge girder in the world was laid recently as part of a railroad bridge at Rock Island on the Mississippi. This giant girder weighs 97 tons and is 114 feet long. Two powerful cranes lifted it.

EUROPE BUILDING MOLDED HOUSES

BESET by a shortage of material and labor, Europe today is experimenting with an inexpensive method of building houses by molding them of a cheap mixture of gravel, sand, and slag with a small proportion of cement. This mixture is said to equal masonry in durability, heat insulation, freedom from cracks, adherence of plaster, and nailing qualities. It is cast in molds made of sections that are fitted together in a few hours. The windows and doors are cast with the walls. It is claimed that these molds can be used at least 30 times.



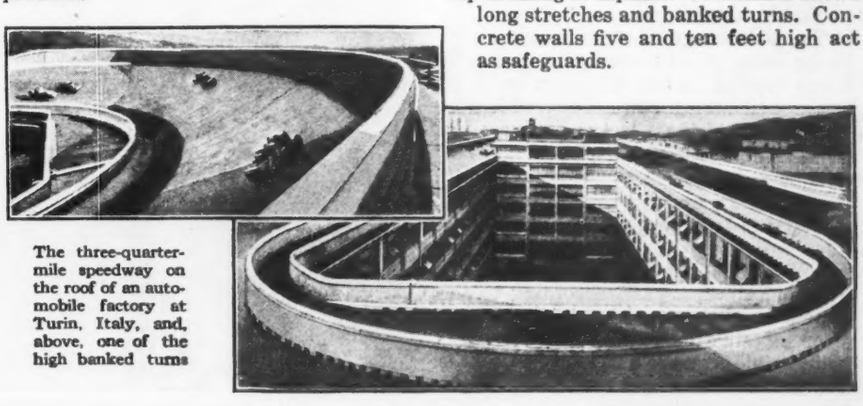
A molded house nearing completion. Note the roof construction

MOTOR SPEEDWAY ON FACTORY ROOF

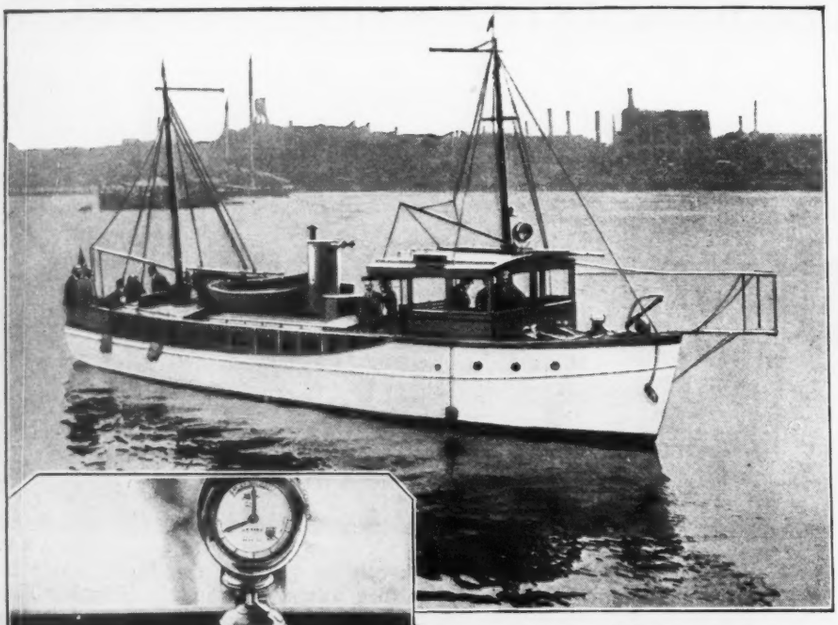
HIGH above surrounding roofs of Turin, Italy, has been constructed the most remarkable motor speedway in the world—a three-quarter-mile track, 70 feet wide, with steep banked turns around which high-powered cars, stripped to their skeletons, dash every day at the greatest speed their roaring engines can produce.

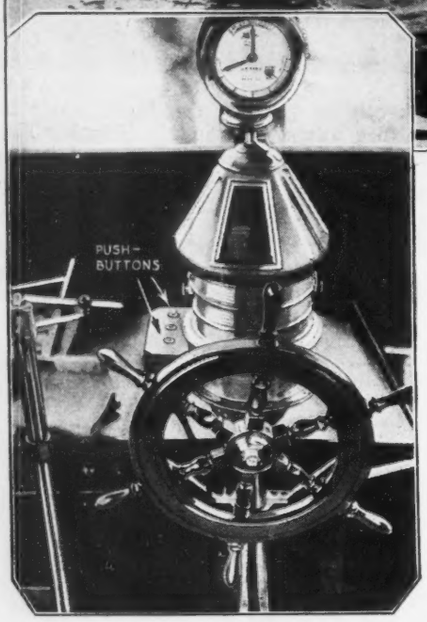
The track is used for testing the cars of a well-known Italian automobile manufacturing company. Each chassis, when assembled, is taken to the roof by elevator and driven around the track at top speed until the staff engineer conducting the test is satisfied with its performance.

The track is of armored concrete with a top dressing of asphalt. It consists of two long stretches and banked turns. Concrete walls five and ten feet high act as safeguards.



The three-quarter-mile speedway on the roof of an automobile factory at Turin, Italy, and, above, one of the high banked turns





The motor yacht *Wanda II* at Bridgeport, Conn. At the left, the pushbutton controls

Motor Yacht Controlled by Three Pushbuttons

WITH what contempt would Columbus, Sir Francis Drake, or any of those storied mariners of old, view the ingenious automatic navigation of this craft! In it three pushbuttons have reduced propulsion control from a matter of sailcraft to the pressure of a finger.

This motor yacht, the *Wanda II* of Bridgeport, Conn., was launched recently. A group of distinguished marine engineers and designers observed her on the trial trip. They are said to have acclaimed the pushbutton control a remarkable success.

The buttons govern an electric motor in the stern. This motor in turn controls a new type of rudder, the latter inclosing the propeller within two concaved leaves. Adjustment of these leaves produces full ahead, stop, or reverse without need of shifting the engine gear.

Finds Oysters Change Sex

OYSTERS change their sex three or four times a year, according to the statement of the Danish scientist Sparck after investigations at the Limfjord experimental station. He believes the changes are caused by variations in the temperature of the water.

Slide Control Simplifies Saxophone Playing

A NEW instrument designed to make it easy for any person to master saxophone playing has just been perfected by a Chicago concern. The outstanding feature is a slide in place of the usual finger stops.

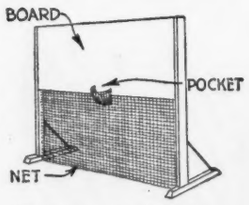
Instead of the usual holes covered by padded keys, the tones of the chromatic scale are produced by means of a slotted tube of unique design, which is soldered longitudinally to the body. Inside the slide is a closed tube that acts as a valve in opening and closing the slot. The notes are produced by moving the tube up or down.

The mouthpiece, reed, and manner of sound production are the same as on the regular soprano saxophone.

Moving a sliding tube produces tone variations

Tennis in Small Space for Any Season

A BALL game for winter or summer, that can be played in a space as small as seven by three and a half yards has been invented and popularized in England. The game is an adaptation of tennis. Any small yard and even a large room can be used.



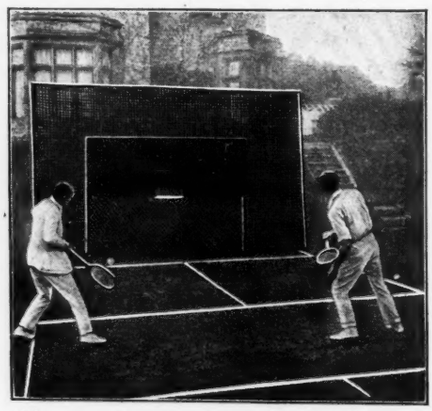
Backstop construction, showing pocket, net, and board

At one end of the court is a rectangular frame holding netting that extends three feet from the ground. Above the netting is a board, fixed between the frame's uprights.

In the exact center of the frame, at the juncture of the board and the net, is a small net pocket.

The player tries to serve the ball into the pocket. Failing in this, the ball will strike either the net or the board. If it strikes the net, the player loses a point. If it strikes the board, the ball rebounds and returns into court just as would a ball served from the opposite side of the court in tennis.

The ball then must be played by the opposing player. The ball is kept in action until one of the players serves it into the pocket, winning the point, or serves it into the net or out of bounds, losing the point. Scoring is similar to that of tennis.



The game in progress on a back-yard court

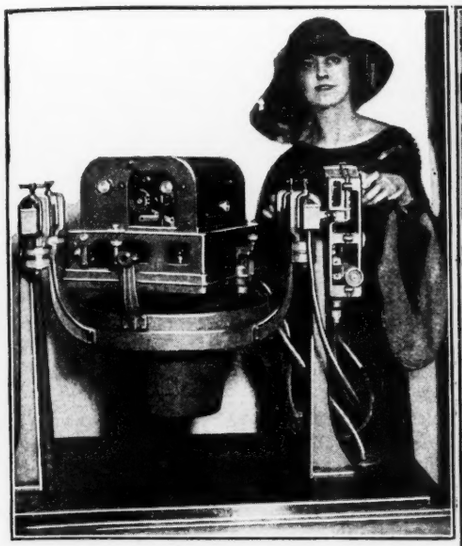
New Plant Diseases Found

A RECENT survey completed by the United States Department of Agriculture shows that hitherto unknown diseases are attacking common American vegetables.

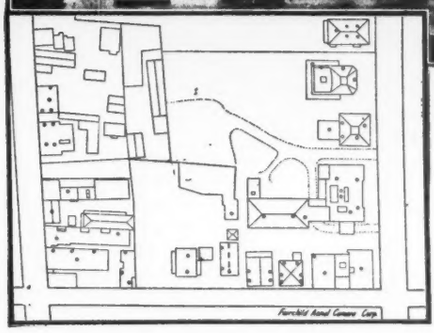
The government specialists found that among the plants affected are tomatoes in California; spinach in Idaho, Washington, and Oregon; Chinese cabbages in Texas; radishes in Missouri; watermelons in Washington, D. C., and Washington State, and potatoes in New York, New Jersey, Pennsylvania, and Vermont.

Most of the diseases, it has been ascertained, are caused by various sorts of parasitic fungi.

Airplane Photos Reveal City Fire Traps



The latest type of automatic camera for airplane photography, run by storage battery



Above is an aerial photograph of a city section, from which the fire map at the left was traced. The photograph reveals fire hazards such as piles of rubbish in vacant lots and automobiles parked so as to obstruct the streets

By G. B. Muldaur

Gen. Agent, Underwriters' Laboratories

THE utilization of aerial photography by municipalities in preventing fires was demonstrated recently in experiments and is recommended by the Underwriters' Laboratories, a non-commercial organization associated with the National Board of Fire Underwriters in the testing of materials and devices designed to eliminate fire hazards.

Many airplane pictures of cities were taken by expert camera men from a height permitting the photographing of buildings, streets, and vacant land in detail and without distortion. The photographs then were pieced together, forming accurate topographical views of the cities. Maps were prepared from tracings of the composite photographs.

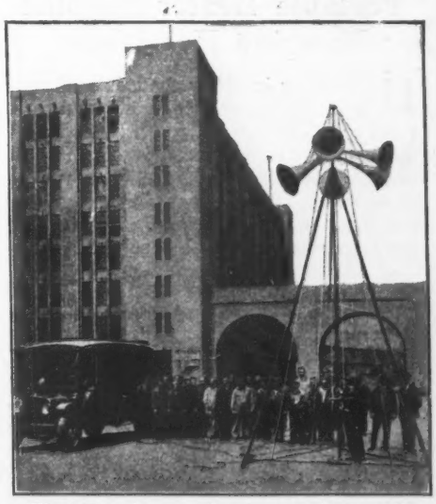
Maps traced from aerial pictures have been found markedly superior in some respects to the insurance maps commonly used to show the physical condition of cities, neighborhoods, and individual structures with relation to fire risk.

As one point of superiority, the preparation of a city map by surveying is a long and tedious process, while an airplane map can be produced with comparative speed, and, by means of an aerial patrol, can be supplemented constantly. Also, the usual insurance maps, which designate various fire hazards by colors and symbols, take into account only structures, giving no definite information of those that may lie in vacant places.

The application of aerial photography to fire prevention was indorsed by Major R. W. Schroeder, former holder of the world's altitude record and now in charge of the aircraft division of the Underwriters' Laboratories.

Officers Give Commands by Loudspeaker

IF 250 lusty-lunged drill sergeants of the Regular Army should get together and join in roaring "Fall in!" the resulting effect, it is said, hardly would equal the noise of a single voice magnified by a huge portable amplifier recently put into operation by the United States Signal Corps.



The officer issues orders in an ordinary voice

The outfit consists of four amplifier horns mounted on a towering tripod. It can be collapsed and transported from place to place in a motor truck from which it is operated. The officer stands beneath the tripod and issues his orders into a microphone.

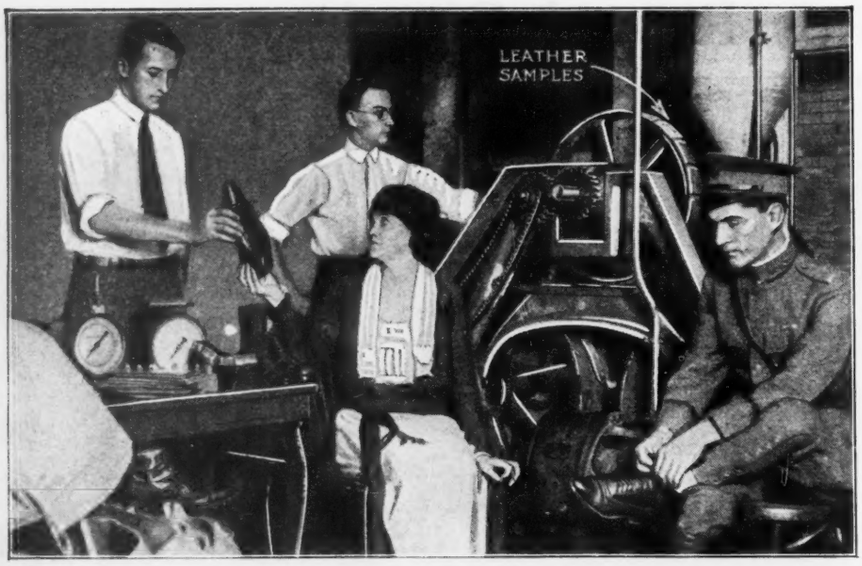
With this equipment, it is claimed, a single officer can drill large bodies of troops.

CLOSED CAR BUILT LIKE SUBMARINE

"Submarine sedanette" designed to protect its occupants from dust

HERE is the latest thing in motor-car novelties — the "submarine sedanette." It is called a "submarine," not because it can be operated in water as well as on land, but because of its body construction, which resembles the conning tower and half the hull of a submersible.

The unusual body design aims to protect the driver and passengers from the white dust that is common on the highways of Europe, where the machine was constructed.



SHOE LEATHER TESTED BY UNCLE SAM

TO DETERMINE the resistance to wear of leather and other materials used in shoes, the United States Bureau of Chemistry in Washington, D. C., has undertaken a series of tests to eliminate undesirable products and to standardize materials.

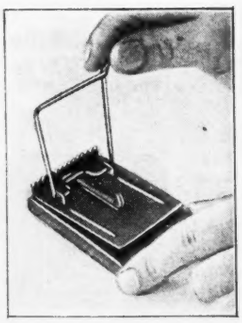
In service tests on 14 pairs of soles, one sole of each pair was of plain leather, while the other sole was treated by a special process to increase the wear resistance. This process consists of covering the entire surface of the soles with stitches looped and locked near the center of the sole. The wood fiber thread used was thoroughly saturated with wax.

The results of the tests show that leather so treated wears about 25 per cent longer to the unit of thickness than untreated leather. The increase in wear appears to be proportional to the amount of fiber material added to the leather.

In addition, several commercial products used in the making of shoes have been tested on a special machine, shown above, that in a few hours subjects the material to the same wear that it ordinarily would be expected to withstand in months of actual service. The effect of wear on wet shoes, and the value of polishes and waterproofing materials, also are being studied.

A Mouse Trap that Won't Catch Fingers

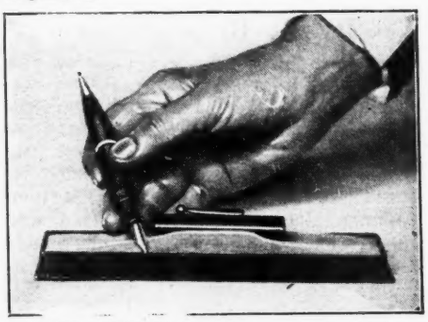
MANY a mouse trap catches more fingers than it does mice. Yet the simple twist of wire shown at the right between the fingers of the operator is said to protect the hands without interfering with the trap.



A twisted wire aids in setting the trap

Pencil in Fountain Pen

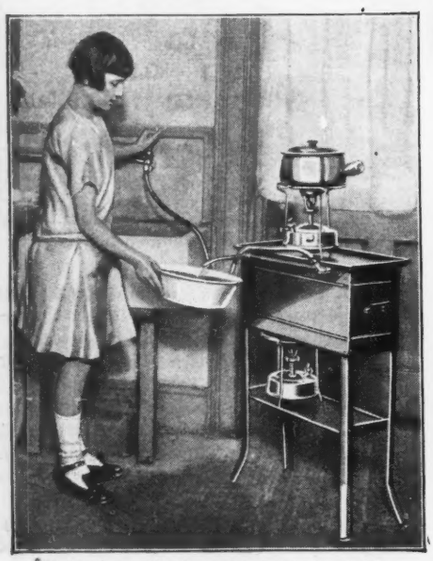
A COMBINED fountain pen and mechanical pencil, the size of an ordinary fountain pen, is one of the latest pocket writing conveniences. The pen portion is self-filling. Pencil points can be replaced.



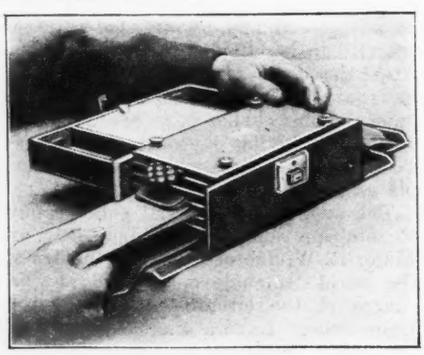
The combined fountain pen and pencil

Portable Heater Supplies Running Hot Water

HOT water in a few seconds and continuously thereafter is supplied by a small portable heater recently invented in England. Denatured alcohol is burned in the device, the heat being conveyed to an ingenious arrangement of coils through which the water circulates. This heater can be used also for light cooking.



Water from the faucet is heated quickly



Handy Case for Neckties Irons out Wrinkles

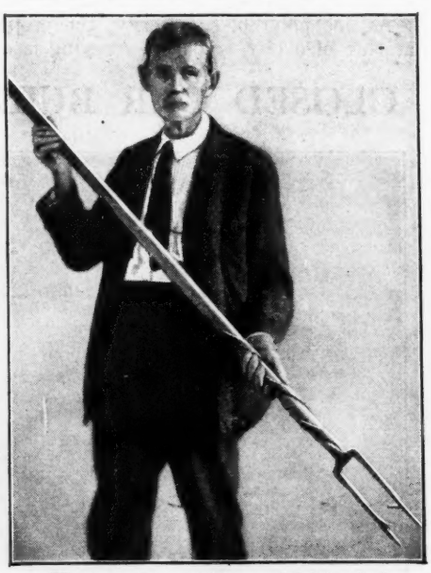
WHAT man, dressing at a sprint 20 minutes behind his social schedule, has not let loose an outburst of temper at finding his favorite necktie hopelessly wrinkled?

This little pressing case is designed to remove wrinkles and to keep ties always neatly pressed. Within the case is a series of stiff fiber plates between which the ties are placed. Pressure is applied to the plates by means of thumbscrews. The ends of the case are hinged so that any tie can be removed without disturbing the whole set of pressing compartments.

Small compartments in the cover of the case are designed to hold collar buttons and stickpins. The entire outfit takes up little room.

Forked Spear Hooks Fishes

APPLYING the principle of the fish-hook to a spearing fork, Solomon T. Henry, of Downsville, La., has created a deadly weapon for fishermen. Both tines of the fork are flattened and each has a recess a few inches from the point. A prong with an upstanding flange extends toward the handle from each recess, swingable outward 40 degrees.



The inventor and his novel fishing fork

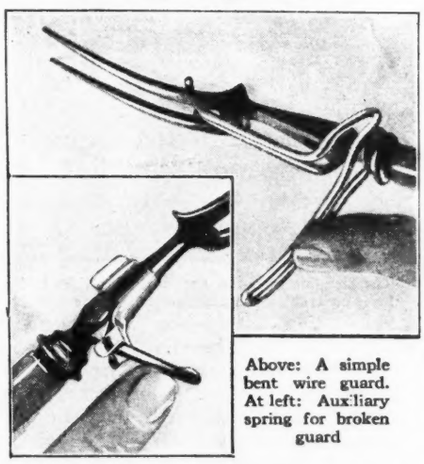
How to Weigh a Letter with Ruler and Coin

DO YOU ever put extra postage on a bulky letter to save a trip to the post office? This simple but effective scales will give you the correct weight of a letter.

Place a 25-cent piece on the 12-inch end of an ordinary foot ruler. Rest the ruler upon the sharp edge of a pocket knife at the six-inch mark. Now hold the letter to be weighed loosely between the thumb and finger, and balance it on the ruler at the 4¾-inch mark. One coin will counterbalance one ounce, the limit for two-cent postage. Two coins will counterbalance two ounces, and so on.

Lest you forget, you might make a circle at the end of your ruler and mark the two graduations to be used.

Ingenious Safety Guards for Carving Fork

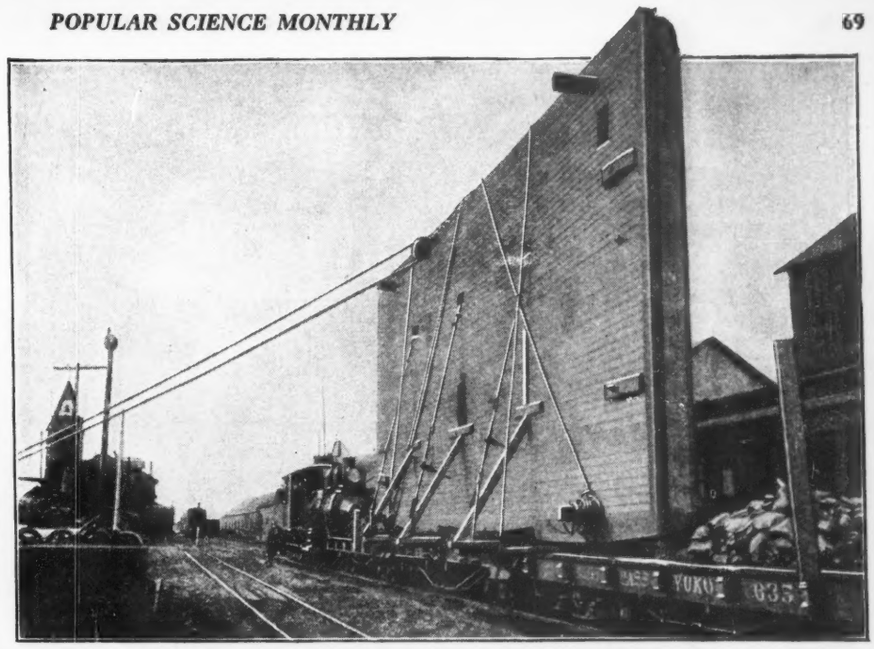


Above: A simple bent wire guard. At left: Auxiliary spring for broken guard

NEARLY every carving fork is equipped with a hinged guard; yet often, after years of use, the spring breaks or the guard is broken. Since it never is safe to use carving utensils without a guard, the two types of auxiliary guards shown above have been invented. The upper illustration shows a wire guard that can be sprung on to almost any carving fork.

The lower illustration shows a spring that can be slipped on beneath the ordinary guard should the original spring break. Either device will prolong the life of a carving set.

AMAZING photographs showing the nature and movements of atoms will be published in next month's issue through the courtesy of Sir Ernest Rutherford, the great British physicist.



BARGE GOES 43 MILES ON FLAT CARS

TRANSPORTING this 21 by 60 foot barge from White Horse to Lake Labarge, in the Yukon Territory, Canada, seemed offhand an impossible task. No water route was available, and the width of the barge seemed to make rail transportation impossible.

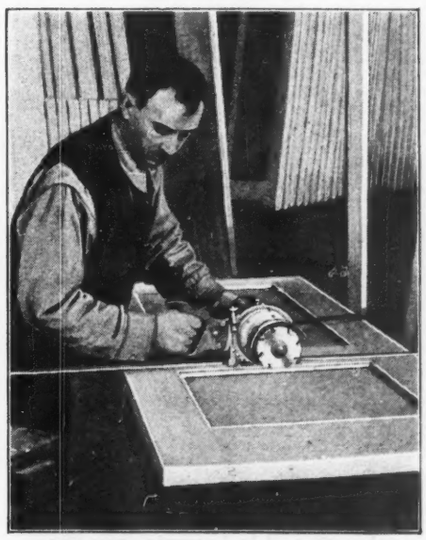
But so sorely was the barge needed for work on a large dam being built in a stream that empties into the lake, officials of the White Pass & Yukon Railroad agreed to try. They waited for the first windless night and then, bracing the barge in a perpendicular position on a flat car, as shown above, they made their cautious way over the 43 miles to the lake. A rising wind might have wrecked the train.

Small Electric Hand Saw for the Woodworker

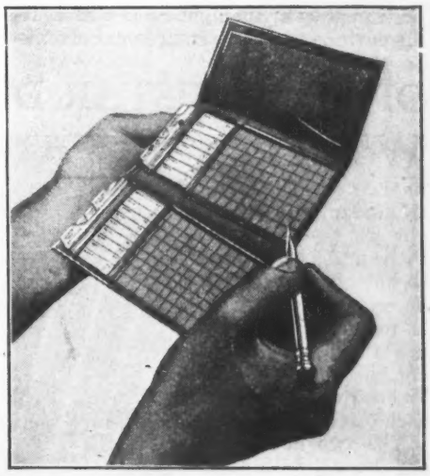
AN ELECTRIC hand saw, compact, light, and usable with all sorts of saw teeth by interchanging blades, has been designed especially for woodworkers.

The tool is moved across the work much like a hand plane. It is eccentrically mounted in its frame and capable of adjustment relative to the frame.

It will cut a groove thirteen sixteenths of an inch wide and one inch deep, or it will take a two-inch cut. It can be used for cutting flooring, making grooves for inlays, fitting doors, cutting through slab doors, and many other operations.



Using the saw to remove a door panel

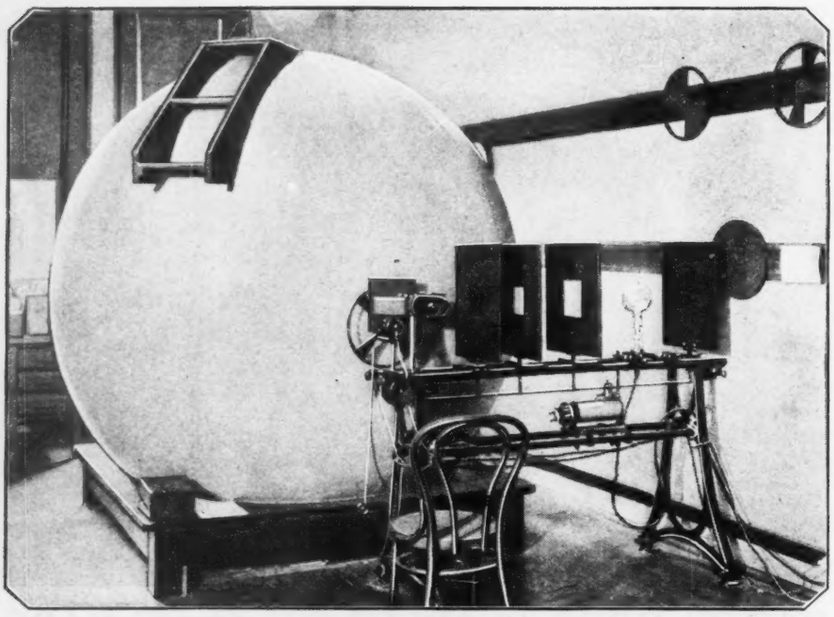


This Bill Fold Contains Handy Score Card

A COMBINATION billfold and score card is a recent invention for sport lovers who like to keep their own box scores, or to keep a running record of golf, basketball, track, and other contests.

In addition to the usual bill compartments, there are two record card pockets with dulled celluloid faces through which the printing on the card is visible. Pencil writing on this celluloid is distinct, yet it can be erased with a damp cloth or a handkerchief. When not in use as a score card, the celluloid surfaces can be used for memoranda.

On the record cards are printed the names of various teams and the players, as well as the record of each player made the previous season.



GIANT BALL TESTS ELECTRIC LIGHTS

A HUGE reinforced concrete ball, hollow, more than seven feet in diameter and painted inside and out with a highly reflecting white paint, is kept at the Bureau of Standards, in Washington, D. C., to measure the candlepower of electric lamps and their brightness.

The lamp to be tested is placed, through an opening in the top, within the sphere, where the white walls centralize the intensity of the light upon a measuring device. A special arrangement of milk-glass windows and tubes permits the observer to study the light while it is in the sphere.

This curious sphere was used in testing the "jewels" for the famous Tower of Jewels at the Panama-Pacific Exposition.

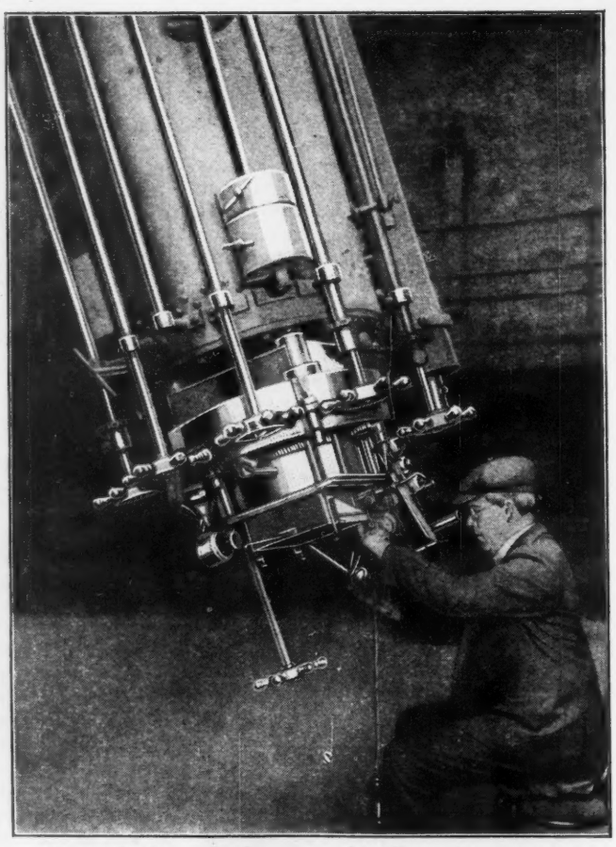
TO DETERMINE whether a fabric is all wool, or part wool, boil a bit in a concentrated solution of caustic soda or caustic potash. The wool portion will disappear gradually.

DISCOVERS STAR DENSER THAN ROCKS

WITH the giant telescope shown at the right, Dr. Frank C. Jordan, of the Allegheny Observatory, Pittsburgh, Pa., claims to have discovered the densest star known to astronomy. It is called a variable star, for it consists really of two bodies revolving about each other.

The two bodies are egg-shaped, with their long axes directed toward each other. They eclipse each other twice in a complete revolution, or at intervals of 170 minutes. These bodies are believed to be denser than the surface rocks of the earth.

The star is so faint that at its brightest the light would have to be strengthened 130 times to make it barely visible to the naked eye. At its faintest, it would have to be strengthened 270 times. Neither its distance nor its actual amount of light is known.



Doctor Jordan and telescope used in discovering new star

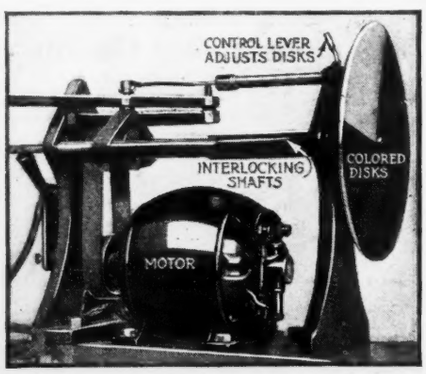
New Disk Machine Blends Colors Scientifically

A MACHINE designed to blend colors scientifically has been invented by Prof. Edwin B. Twitmeyer, of the Department of Psychology, University of Pennsylvania. The problem is one that has defied the ingenuity of scientists for many years.

Advertising experts, textile makers, eye specialists, and interior decorators are among those who will benefit from the studies into the principles of their arts that the device is said to make possible.

The basis of the machine is two colored disks, fitted together so that parts of each show as the disks revolve rapidly on a shaft. Such devices, in crude form, long have been used to demonstrate the striking effects of colored lights when combined. These effects are quite different from those of colored pigments. For example, as every school child knows, green is obtained by combining blue and yellow. Yet blue and yellow disks, when spinning together, give a grayish white.

The ingenious feature of Professor Twitmeyer's machine is that the position



The blending machine, showing color disks and lever controlling the amounts of color exposed

of the disks may be changed while the shaft is in motion, varying the visible amount of each color. The exact ratio of the two colors is shown by a graduated scale at the top. Spotlights may be trained on the disks and used to add still more colors to the combinations.

Colored Silks Are Used to Imitate Marble

THE ingenuity of scientists in creating substitute, or imitation building materials is strikingly demonstrated by the recent invention of a "marble" that can be manufactured on the job.

By this process, derived from Italy, a net of colored skeins of silk is laid on a piece of oilcloth. Over the silk and cloth is spread a layer of special cement. After the cement has stood for a few minutes, the silk is withdrawn.

The slab then is levelled carefully and covered with a strip of cheesecloth and a layer of dry plaster.

When the cloth and plaster are removed, there appears a slab of putty-like cement in which is a colored pattern left by the silk. This pattern is said to duplicate almost exactly that of natural marble.

Geologists Brave Floods to Map the Colorado

FACING death almost constantly while their boats were swept along by flood rapids in the Marble and Grand canyons in northern Arizona, 11 members of the United States Geological Survey recently completed what has been called the most dangerous enterprise ever undertaken by government agents during peacetime—the mapping of the treacherous waters of the Colorado River and exploration of the canyon gorges.

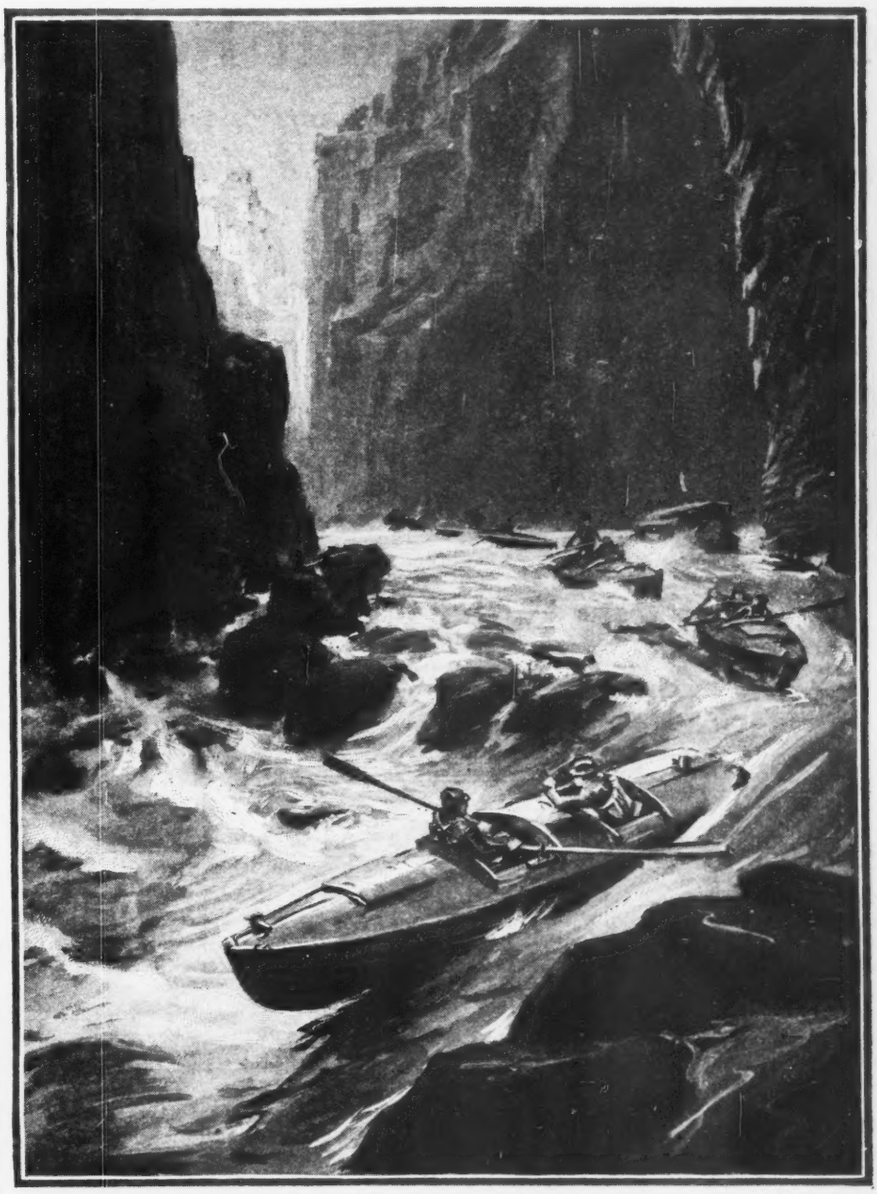
Three months were required by the expedition to traverse 300 miles, a day's journey for a fast automobile.

Four boats, specially constructed and fitted with air chambers, carried the members of the party, who were strapped into the cockpits and wore life preservers during the entire time they were afloat. A radio receiving set furnished their only means of communication with the world.

At one time, during heavy floods in the Colorado, the outside world believed the entire party had perished in the deluge.

When the explorers at last reached civilization, stripped to the waist and tanned as dark as Indians, they told a dramatic story of their narrow escape from death.

A bird's-eye map of the treacherous Colorado River canyons explored by the government geologists



How the explorers, strapped in boats fitted with air chambers, rode the Colorado rapids

One night the river rose 20 feet and multiplied its volume 10 times. They spent the night struggling to protect the boats. One boat was hauled up the face of the canyon wall by block and tackle, while others were moved to points where they could be dragged up ahead of the flood.

The mapping of the Colorado has been in progress since 1909. As a result of the recent expedition, complete records are now available of more than 1200 miles of the Colorado and Green rivers and their principal tributaries. The expedition was in charge of Col. C. H. Birdseye, chief topographic engineer of the Geological Survey.

HOW MUCH DO YOU KNOW ABOUT SCIENCE?

THAT science touches the every-day lives of our readers at a thousand points is evidenced by every mail. Scores of questions, as varied as science itself, come daily to our Information Editor. From these have been selected the dozen typical queries printed here. To test your knowledge, see how many of these you can answer correctly.

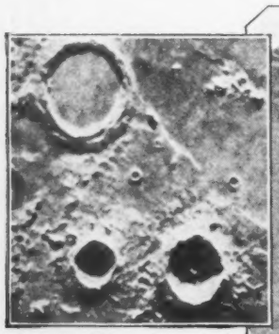
It's a fascinating game in which you can't lose. Even though you fail to make a high score, you will gain useful scientific knowledge. So whet your wits and try them out. When you have finished, turn to page 135, and check up your answers.

There will be another dozen next month.

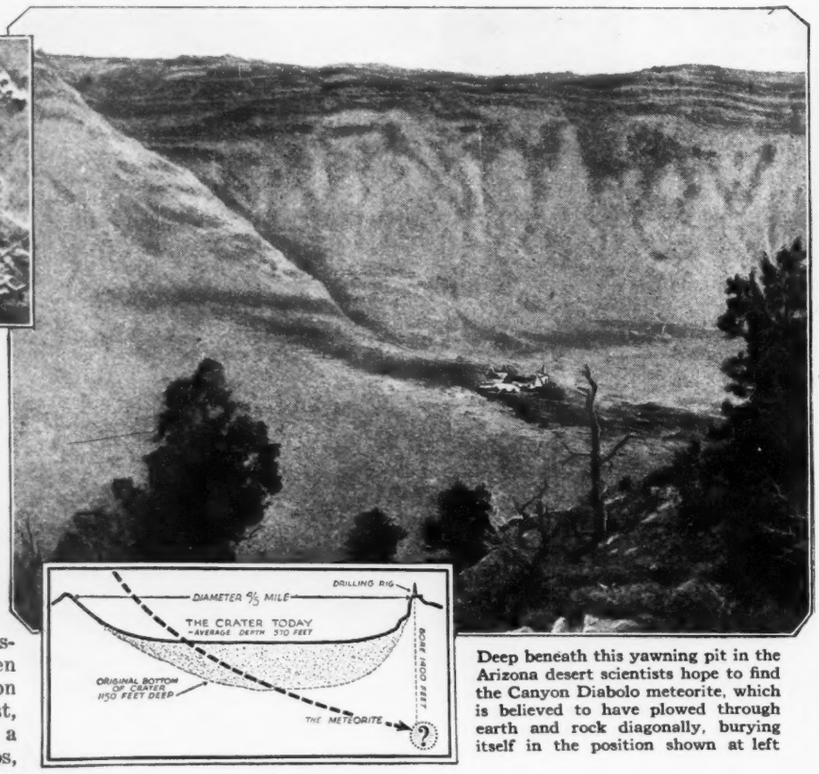
1. ***Why do we grow old?***
2. ***What is the difference between soft coal and hard coal?***
3. ***What is the fastest thing in the universe?***
4. ***Why is London time different from New York time?***
5. ***Why must ice cream be stirred while freezing?***
6. ***Why is it that a hurt received while you are excited is seldom felt until afterward?***
7. ***What is a rainbow?***
8. ***Is perpetual motion possible?***
9. ***Why do vacuum bottles keep things hot or cold?***
10. ***Can diamonds be made artificially?***
11. ***Why does wool shrink when it is wet?***
12. ***Why does the hair grow thickest on top of your head and very little over the body?***

A Treasure that Fell from the Sky

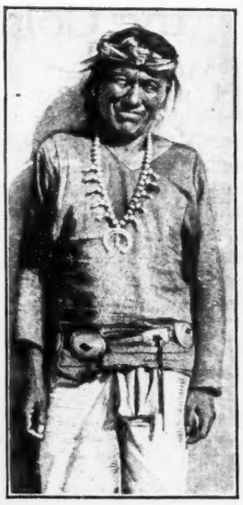
Scientists Believe a Fortune in Minerals Is in Meteorite Buried in Arizona Desert



Craters on the moon, from an astronomical photograph. Some scientists believe they were formed by the impact of enormous meteorites—a theory based on their resemblance to earth's meteorite craters, such as the great Arizona crater shown at the right. Some of the craters on the moon are 60 miles in diameter



Deep beneath this yawning pit in the Arizona desert scientists hope to find the Canyon Diabolo meteorite, which is believed to have plowed through earth and rock diagonally, burying itself in the position shown at left



Brown Hawk Wing, wise man of the Navajos, who recites the Indian legend connected with the crater. He relates that three Indian gods, seeking eternal rest, rode to earth on flaming thunderbolts that cleaved for them a wide-mouthed canyon grave

IN THE Arizona Desert, midway between the Grand Canyon and the Petrified Forest, Brown Hawk Wing, a wise man of the Navajos, tells a story that is generations old. Like many legends of once savage folk, it parallels with uncanny accuracy the scientific explanation of a weird phenomenon of nature.

Ages and ages ago, the Indians say, three of their gods, seeking eternal rest, rode to the earth on flaming blue thunderbolts that cleaved for them a deep and wide-mouthed grave.

Therein those gods still lie, runs the legend, in their endless sleep, covered with rocks and iron and a pure white dust that is fine as flour. And terrible is the fate that will clutch the desecrators of their slumber!

That is the Navajo version of the fall of what science calls the Canyon Diabolo meteorite, a huge lump of celestial matter that is believed to lie embedded in the solid rock, 1400 feet below the desert sands, beneath the 570-foot crater that it blasted out when it plunged flaming from the sky.

For 40 years the Navajos have been shaking their heads and prophesying evil as they have seen the white man's machinery set up at the crater's edge and his drills bite into the tomb where sleep their gods. For mining engineers believe that the buried meteorite is a giant treasure chest of iron, nickel, platinum, iridium, and other valuable minerals. The size of the celestial visitor has been variously estimated as between 300 and 1000 feet in diameter and its weight as between a few thousand tons and many million. Twenty years' digging has failed to locate the treasure.

The Navajos wag their heads sagely, saying that their gods know how to protect themselves, even in death.

Recently, though, the seekers were given a favorable sign. The steel point of an oil drill, boring into the rock, was shattered against a substance harder than itself. Was it the meteorite? The engineers are assuming that it was and have sent for additional mining machinery to sink a shaft. What the drill struck is more than 1400 feet below the surface.

The sinking of the proposed shaft will enable the engineers definitely to ascertain if the mysterious substance was a part of the long-sought treasure. But its sinking is likely to prove a difficult task.

At one time the pit was thought to be of volcanic origin, and the meteoritic fragments that lay about it and lent color to the meteor theory merely a coincidence. Modern science, however, has caused this theory to seem quite untenable, since in no part of the surrounding region—or in the great pit itself—is there any mark of volcanic action.

So for some years it has been regarded as the handiwork of a monster meteorite. However, it is believed that the vast object is not embedded in the center of the pit, but to one side of it, this latter circumstance being due to the fact that the lump of matter fell obliquely through space and continued its slanting path after it had struck the earth.

The crater has a form that resembles on a giant scale a lump of mud or soft plaster into which a ball has been thrown. Much of the interior of the bowl is composed of white "rock flour," believed to be pulverized sandstone that was ground beneath the meteorite in its fall. Layers of gray sandstone, and, below the "rock flour," red sandstone that was not disturbed by the falling body, compose the rest of the crater.

Specimens of the meteoritic fragments are of such interest, that tons of them have been removed and placed in museums.

Natural conditions, climate, and the presence in the neighborhood of thousands of rattlesnakes and rats, impede the progress of the mining operations. But they are being carried on whenever possible and their results will be awaited with eagerness both by the scientific world, which is seeking corroboration of its theory, and by the general public, which cannot but be thrilled by so dramatic a project as that of digging out a treasure chest fallen, centuries ago, from the sky.

A typical Canyon Diabolo meteorite fragment, weighing 357 pounds. Many thousands of smaller specimens, like those at the base of the stand, have been found about the huge crater

Automobiles of 1924 Show Marked Mechanical Improvements

By H. Clifford Brokaw
of Society of Automotive Engineers

PRACTICALLY every one of the 110,000,000 persons in the United States either owns an automobile or rides in one belonging to some one else.

The 13,000,000 Americans who own cars today, almost without exception, are planning for the time when they will get new machines. And those who do not own them are looking forward to the time when they will. Consequently, the apparent tendencies in automobile construction, as indicated by the 1924 models of various makes, are a matter of almost universal interest. These tendencies represent an increased value that the mechanical and manufacturing genius of automobile companies is giving in the latest models.

An Even Choice

Often I am asked, "What is the best car on the market?" There is no such thing as the "best car" so far as I know. Certainly, all new features cannot be obtained in any single 1924 model. One car may have one especially good feature, but another car may have an entirely different improvement that fully offsets the advantages claimed by the first. Yet it is safe to say that practically every standard 1924 model is reasonably near in value to the price that is set on it.

One would need to write a book to go fully into the whys and wherefores of all the new features that are claimed for the 1924 automobiles. It is possible here, however, to point out enough of the more important features to give prospective car owners a general bird's-eye view of the situation—to give them a yardstick by which they can measure the value of these new features in the automotive field.

Like a yardstick, the mechanical improvements found on the 1924 automobiles are divided logically into three parts—first, the body of the car, which shows remarkable results of engineering skill; second, the chassis, which includes such items as brakes, transmission, wheels and tires; third, the engine.

New Models Blend Hood and Body

The design of automobile bodies shows a decided tendency toward a blending of the hood with the body. Evidence of this fashion is notable especially in the Dodge and Buick. The Buick has evolved a decided change in the hood lines. In addition, it has a larger body, and a radiator of new design.

One of the most spectacular of the 1924 changes in body design is seen in the Overland Champion. The versatile person will find a wide variety of possible uses to which this new inclosed model can be put. Both the front and rear seats are removable. When these are taken out, the car can be converted into a cozy bungalow with 50 cubic feet of space. For touring and camping, this design has many commendable points. For example, it is possible to make up a bed on the floor of the car—a bed in which a person actually can stretch his limbs in comfortable repose. In addition a novel mechanical device makes it possible to adjust both front and rear seats backward and forward. This feature insures comfort for motorists with long or short legs.

Other cars, the Dodge for example, have removable rear seats, making it possible for a farmer to carry his produce to market, a housewife to transport the results of her shopping tour, or a business man to cart all manner of goods to customers.

In fact, a noticeable tendency in almost all 1924 models is to provide increased space inside. This assures greater comfort. It enables owners to carry more passengers and more baggage. It is possible now for a fairly large family to go on tour with ample baggage without being cramped for room.

In the Ford group, the coupé has an enlarged rear compartment and an entirely new body design that gives it much more attractive lines. Other improvements on this model include a windshield visor, nickel fittings, new rear fenders, deeper cushioned seats, cowl ventilator, side door that opens forward, and a larger oblong rear vision window. On all Ford models the new radiator sets an inch higher than formerly. An apron on the bottom of the radiator joins a similar apron effect of the fender on each side. This change, in addition to improving the lines of the cars, increases the cooling efficiency.

Frames Stiffened

In the Star, too, will be found a change in radiator design. The frames of both the 1924 Star and the Durant are stiffened by the "tubular backbone." This is a metal tube of comparatively large diameter running lengthwise with the frame.

In both the Dodge and the Nash the instruments on the dash have been grouped more closely on a panel. This not only improves the appearance of the instrument board and provides a unit in which all instruments are lighted easily by a single bulb. The same tendency also is noted in some other makes.

The Nash Victoria Six has a new body design. Windshield wings and a motometer have been made part of the standard equipment of the Nash sport model. In the Nash touring car are found wider and deeper front seats.

The Reo has attained a lower swung body through offsetting the frame more than previously improving the appearance.

The new Jordan Victoria, the Wills Sainte Claire Gray Goose Special, the Oakland True Blue Six, the Moon Salamancas, the Maxwell Traveler, likewise the new

Enough Autos for Everybody

THERE are enough automobiles in the United States to carry every man, woman, and child at one time. With some 13,000,000 cars registered, including buses and trucks, this would mean only about eight persons to each automobile.

The average price of an automobile today—about $750—brings the ownership of a car within the income of almost every family. In 1922 more than 2,500,000 cars were manufactured and the 1923 production was close to 4,000,000. January, 1924, sees the automobile industry the largest in the country.

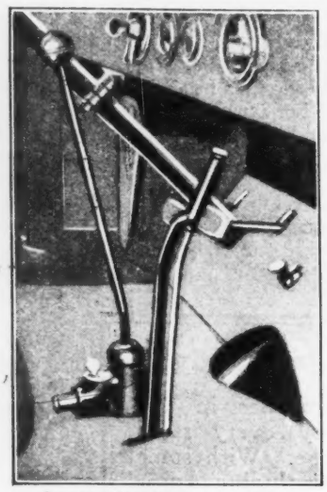
The new car you have ordered probably is being made now. Read what Mr. Brokaw, an experienced automobile engineer, says about what you will find in it. If you have not ordered a new car, but expect to, Mr. Brokaw's survey of 1924 improvements will help you make your choice intelligently.

Convenient rear-end touring trunks are part of the standard equipment of numerous 1924 models. Here the trunk is shown in use on a Chevrolet sedan

Kissel speedster and coupé models, the Cadillac, Case, and Auburn—all have striking improvements in body lines.

On the new Maxwell club sedan the two doors, one on each side, have the unusual width of three feet. Each door is mounted on four hinges and opens forward, giving access at once to both the front and rear compartments. In the 1924 Hudson and Essex coaches aluminum bodies are a commendable feature.

Side curtains opening with the doors, sun visors and windshield wipers are new on the Chevrolet, which, like the Jewett, has made use of a new development in body finishing. Instead of the usual application of paint and varnish, a baked enamel finish, such as heretofore has been applied to fenders or mudguards, is now applied to the entire body. So much for body changes.



Among other improvements on the Jewett, the gearshift lever has been lengthened and its angle changed to bring it conveniently under the driver's hand

Chassis Designs

Among chassis improvements, perhaps the most conspicuous is the introduction of four-wheel brakes on several makes, including Buick, Oakland, Cadillac, Rickenbacker, Packard Eight and Marmon. Here is a distinctly useful advance in motor-car construction at a period when the highways are becoming dangerously crowded with motor vehicles. Safety first is the aim of the four-wheel brakes, now that motorists are the chief cause of the 75,000 accidental deaths that occur each year in this country.

Four-wheel brakes undoubtedly enable the driver to bring his car to a stop quickly; yet the use of brakes on the front wheels has presented very definite problems, including: (1) The action of brakes must not interfere with steering; (2) The braking effort must equalize properly at all times; (3) The brakes must operate with ease and directness.

Solving Mechanical Difficulties

Because of the difficulties in solving these problems, some engineers insist that four-wheel brakes have not yet been developed to a point of absolute safety. On the other hand, designers of the cars using the system this year claim that the mechanical difficulties all have been solved. To assure safety in steering, the front wheels are inclined inward, or undergathered, and the steering knuckle pins are set at such an angle that they point directly at the spot where the tires touch the ground. This is said to eliminate the tendency to change the direction of the wheel—a tendency that would exist if one brake should hold more than another. Equalizing bars or cables similar to those used when only two brakes are employed, and an equalizer between the front and rear pairs of brakes are designed to equalize the braking power.

In turning corners the outside front wheel revolves faster than the inside one. Therefore, if the brakes were applied equally, the outside wheel naturally would transmit more of the braking power than the other. To overcome this difficulty, the Buick brakes are so designed that the brake on the outside front wheel does not operate if the brakes are applied while turning a corner.

To Avoid Locking

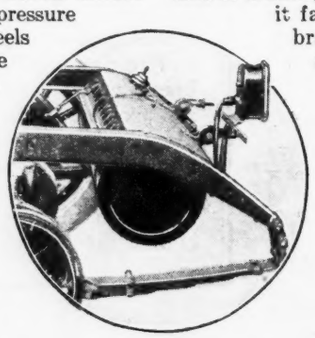
To facilitate the operation of the four-wheel brakes the Packard Company has installed planetary gearing attached to the brake pedal. This is so designed that it gives quick action to take up lost motion in the linkage and increases leverage when the brake shoes contact with the drums. The brakes also are designed so that locking the wheels is practically impossible.

For the Rickenbacker four-wheel brake system the claim is made that whether the car is turning or is on the straight-away, the action of the brakes is unchanged; that the front wheels cannot be locked and that the pressure exerted on the rear wheels always is greater than on the front. Other advantages claimed are that these brakes are automatically lubricated, that they cannot freeze in winter, and that they have the same braking power going backward as forward.

In the use of the balloon air-cushion tire at least two manufacturers have offered a striking 1924 answer to the growing demand for greater comfort and safety in motoring. The Cole car has adopted these tires as standard equipment. They are found, too, on some models of the Moon.

Probably every motorist has observed that when the common pneumatic type of tire is inflated to from 40 to 90 pounds, as specified by the manufacturer to insure its full life, it absorbs little of the road's inequalities. It is necessary to call upon the springs to take up light and heavy shocks. Balloon tires are expected to eliminate the need of supplementary springs and other shock absorbers. Because they are inflated at low pressure and have large diameters, these tires, it is claimed, can absorb shocks that heretofore have been passed on to the body springs, and thence on to the occupants of the car.

Because of increased surface contact with the road, balloon tires are said to result in increased braking power and less liability to skid. Other advantages claimed are lower upkeep and repair cost, due to restricted vibrations, and decreased liability to blowouts on account of reduced air pressure.



Rear springs of the 1924 Dodge, showing protection for gasoline tank and stop light as standard parts of the car instead of extras

The New Traffic Transmission

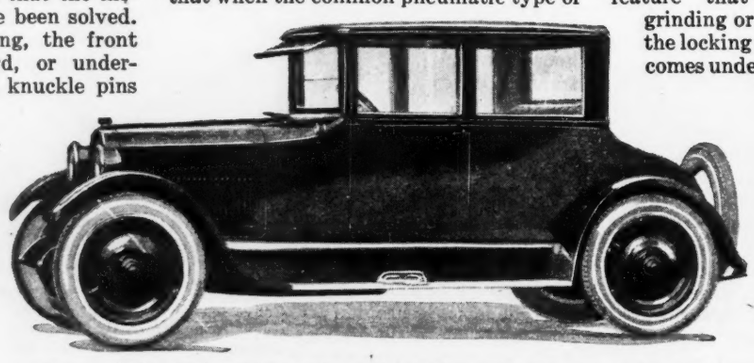
The outstanding 1924 development in transmission gears—that unit of the automobile which until now has remained practically unchanged since its inception—is found in the Chandler traffic transmission.

In this gear, control of speeds is obtained through a lever in the ordinary way, but all gears are always in mesh. This feature eliminates the grinding of gears when an inexpert shift is made, and is designed to make driving in heavy traffic easier. It also permits shifting to a lower gear instantaneously without loss of momentum to the car when climbing hills or crossing railroad tracks. Further, it facilitates shifting to obtain braking power when descending a hill. As in other transmission systems, all gears are made fast to the jack shaft.

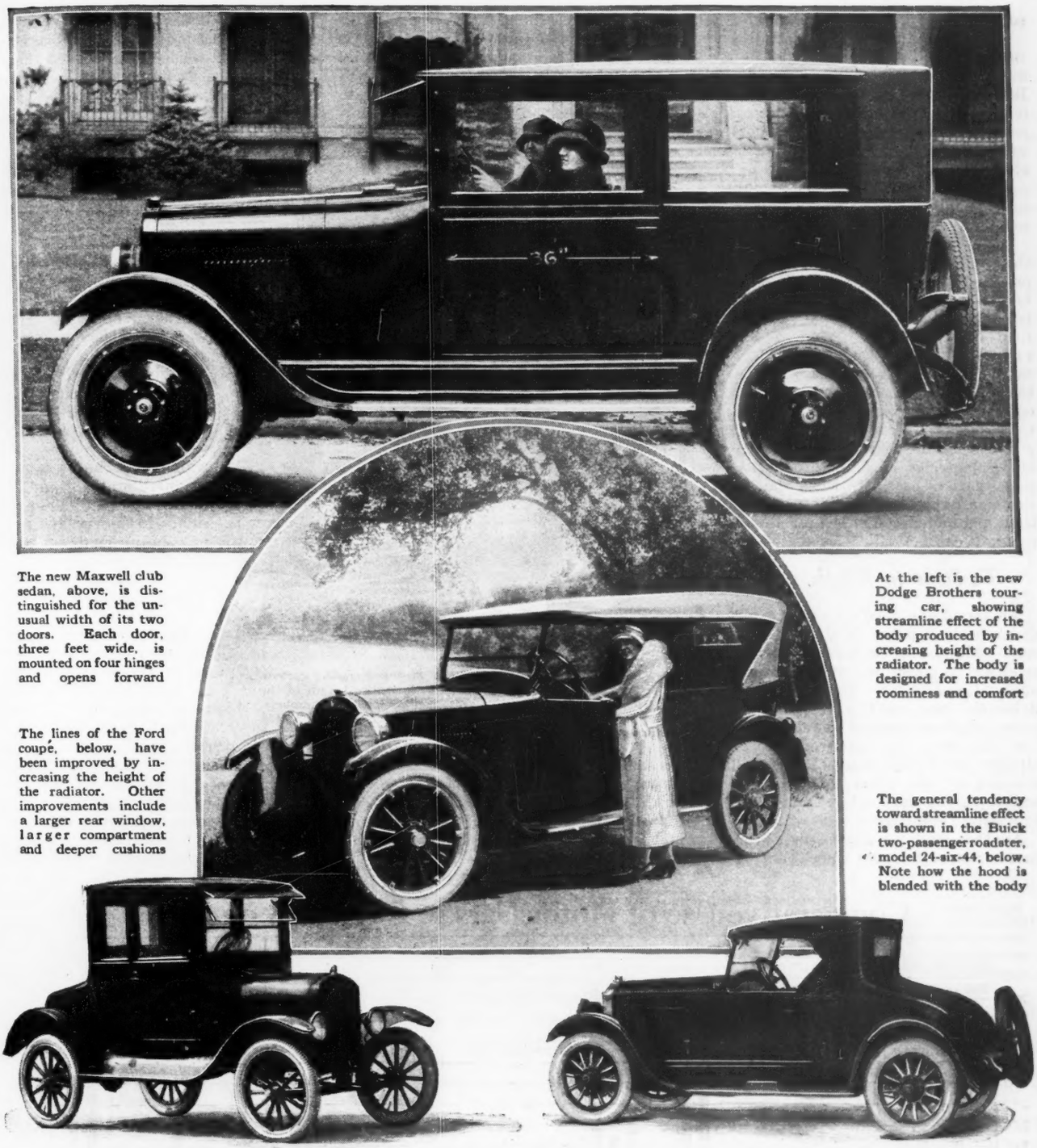
Gear Operation

The jack shaft is attached to the propeller shaft, and all gears may turn freely. To operate first speed gear, for example, a key or rod of comparatively large diameter slides into contact with teeth on the inside of the gear, with the result that the gear is locked to the shaft. The construction is such that this locking does not become effective until a cam on the road is in full mesh with the gear—a feature that eliminates possibility of grinding or of chipping off the edges of the locking parts. The fact that the key comes under a compression, rather than a shearing strain, saves it from wear or breakage.

Advantages claimed for the new transmission are these: Elimination of gear clashing and "dub" shifts; the possibility of instant change of gears up or down; and of engaging any desired gear under any condition; ease in maneuvering, less skidding; saving of time, nerves, and repair bills.



Reo coupé, showing lower slung body, steel disk wheels with demountable rims, and step plates, all part of the equipment. Under the rear deck is a roomy compartment



The new Maxwell club sedan, above, is distinguished for the unusual width of its two doors. Each door, three feet wide, is mounted on four hinges and opens forward

The lines of the Ford coupé, below, have been improved by increasing the height of the radiator. Other improvements include a larger rear window, larger compartment and deeper cushions

At the left is the new Dodge Brothers touring car, showing streamline effect of the body produced by increasing height of the radiator. The body is designed for increased roominess and comfort

The general tendency toward streamline effect is shown in the Buick two-passenger roadster, model 24-six-44, below. Note how the hood is blended with the body

In the 1924 Apperson is found a transmission system in which the shift from one speed to another is made automatically when the clutch pedal is pressed. Instead of the usual gear shift lever, a selector handle is placed just under the steering wheel. To shift to a certain gear, the selector handle is moved to the proper position, the clutch is thrown out, and automatic mechanism shifts the gear. When the clutch is engaged again the new gearing is in mesh. Advantages claimed are that the selector lever is in a more convenient position than the usual gear shifting lever and that the automatic feature eliminates grinding or clashing of gears. This gear shift should not be confused with the electric shift already in use, although its action is very similar.

Among chassis improvements in the Hupmobile are longer wheelbase and frame, and a marked increase in the length and width of the springs. The new clutch is of an entirely changed design, using two spring steel plates, permitting a more rapid and silent shift. The weight of the driven member in the clutch assembly has been reduced nearly 80 per cent, making for ease of shifting. The metal has been strengthened to compensate.

The height of the shift lever, now 25 inches, gives greater leverage and convenience. All gear faces have been enlarged and all gears increased in diameter.

The diameter of brake drums has been increased from 12 to 14 inches on the Jewett and the emergency brake has been completely redesigned. All wheels have been made heavier. The front seat has been built to give more foot room for the driver and the gear shift lever has been lengthened to simplify operation.

The Dodge chassis has longer rear springs, the front axle has a drop, and the wheelbase has been lengthened. The gear shift and emergency brake levers have been moved forward to give more leg room, the spark and throttle have been made shorter, the wheels are dished, and the splash pan is concave instead of convex. The fuel tank has increased protection.

On the Studebaker, all the surfaces of the crankshaft are machine tooled for the purpose of reducing vibrations. The Oldsmobile has adopted a fabric type of universal joint, which also is found on

some other well known automobiles.

A chassis hung several inches lower than on any previous model is the most distinct change embodied in the 1924 Reo. An improved rear axle is a further feature of all these latest models. This new axle effectively combines most advantages of the old full-floating axle and of the later semi-floating types.

Even greater sturdiness is accomplished by the addition to the chassis of a torque rod at the rear.

A new device for extracting dirt from the air drawn into the cylinders is found on the 1924 Rickenbacker. It is a well known fact that much of the carbon deposited in the cylinders is road dust that has been carried in through the carbureter. To clean the air the Rickenbacker motors are equipped with a contrivance that causes the air to blow against a mushroom-shaped head. The heavy particles of dirt, through their inertia, pass by, while the clean air for the carbureter is taken from the under side of the mushroom, or cap.

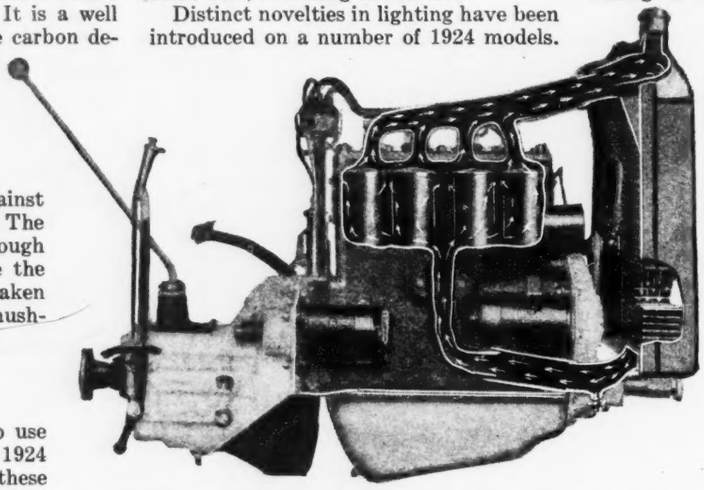
Fashions in Wheels

An increasing tendency to use disk wheels is noted in the 1924 cars. Many models have these solid wheels either as standard or optional equipment. The Studebaker, Oakland, and Chevrolet are among the newcomers in this class. The Maxwell has changed to straight tire valves on disk wheels. The Studebaker also offers combination tail and stop lights and front and rear bumpers as standard equipment.

Another tendency in chassis construction is toward a longer wheel base. Evidence of this is found in the Dodge, Wills Sainte Claire, and others. The result is said to produce greater beauty of line and increased ease in riding.

The new Chevrolet includes the Alemite lubrication system as a standard equipment. This means that the old style grease cups are eliminated. A high pressure gun forces out the old grease, cleans the bearings and lets new grease flow in. This provides ease in lubricating the chassis and quiet running of the car. Pressure systems of a similar nature are used on other cars, including the Jewett.

Distinct novelties in lighting have been introduced on a number of 1924 models.



The new Hupmobile engine, showing the improved cooling system. Water jackets surround each cylinder for the entire length of the piston stroke, as well as all valve seats and combustion chambers. A larger hose connection and manifold outlet deliver the heated water more rapidly to the radiator, thus assuring more rapid cooling

On some Chevrolet models the headlights are reversible so that light may be thrown on the engine. Also the road back of the machine on either side of the highway may be illuminated. Drum lights have become even more popular. While they light the roads no better than other types, they are considered more artistic. The Dodge and Nash models have adopted them.

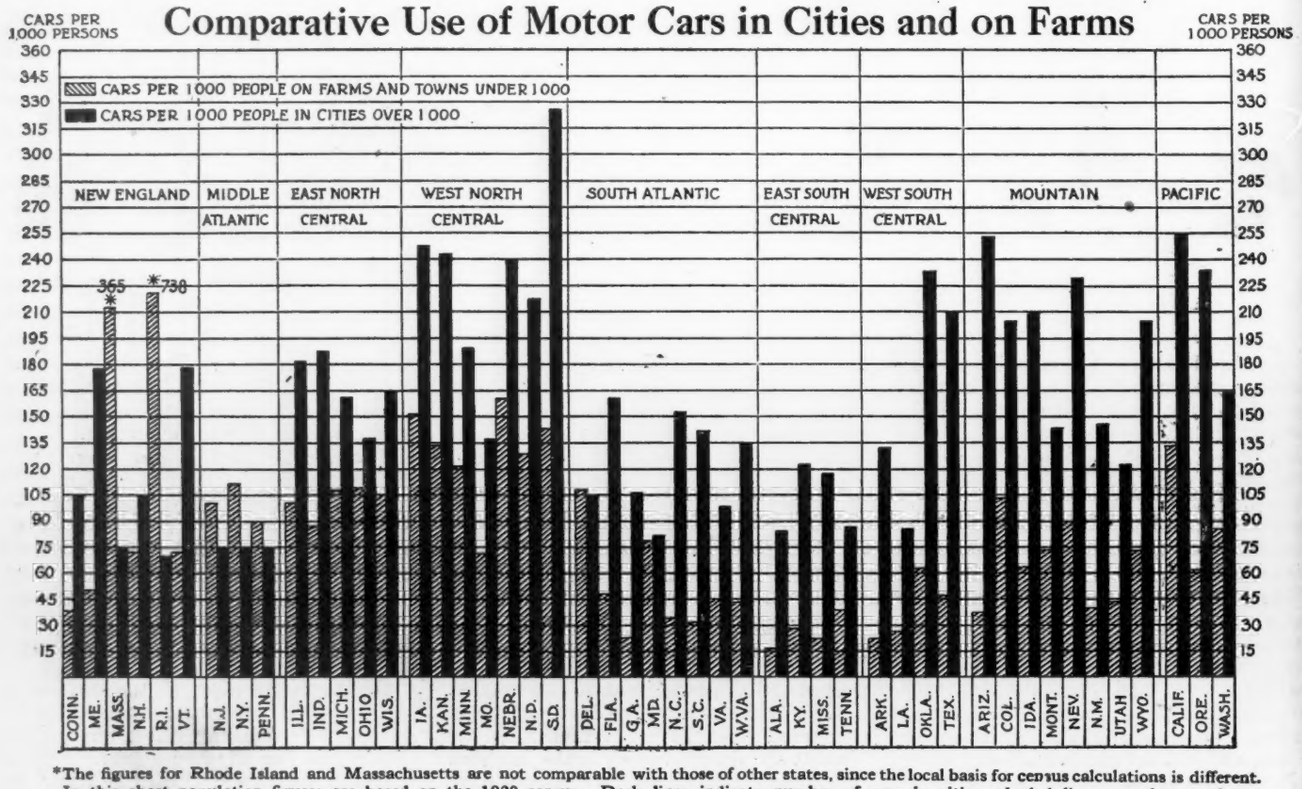
One of the most remarkable improvements in engine design is found in the Packard Eight, in which the eight cylinders are placed in a single line instead of in the conventional V formation. The purposes are simplicity and accessibility of the engine as well as better body lines. The possibility of transverse and torsional vibration that might be expected in an engine of this length is eliminated by providing a crankshaft of comparatively large diameter supported in nine bearings.

The Hupmobile has a new motor, larger and more powerful than before, although its weight is only five pounds greater. A significant innovation is the new crankshaft, which now weighs 57½ pounds, and which has been counterbalanced statically and dynamically with great precision. Moreover, the throw has been made straight, supplanting the angle.

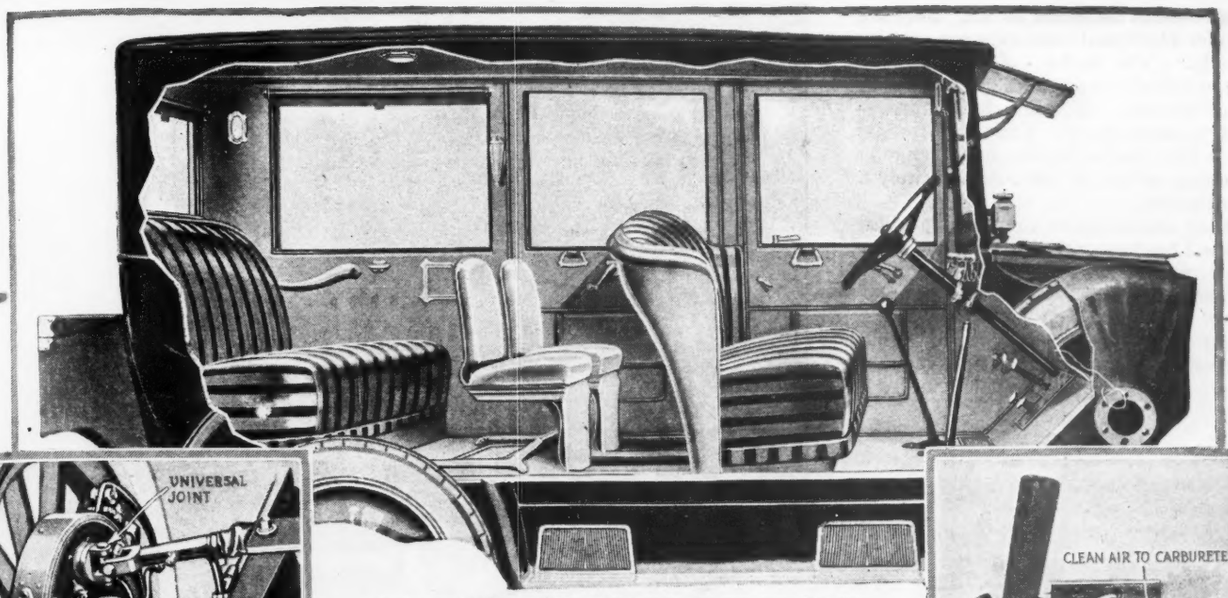
For a Cool Radiator

The Hupmobile camshaft has been made 55 per cent stiffer by enlargement, and its total bearing area has been increased 25 per cent. The cylinder block has been redesigned so that a water jacket surrounds the cylinders for the full length of the piston stroke. Enlarged cylinder outlets now deliver the heated water more rapidly to the larger radiator, cooling it more quickly. Another new engine development is found in the

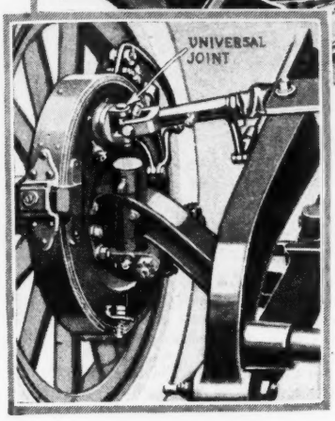
Comparative Use of Motor Cars in Cities and on Farms


CARS PER 1000 PERSONS
CARS PER 1000 PEOPLE ON FARMS AND TOWNS UNDER 1000
CARS PER 1000 PEOPLE IN CITIES OVER 1000
NEW ENGLAND
MIDDLE ATLANTIC
EAST NORTH CENTRAL
WEST NORTH CENTRAL
SOUTH ATLANTIC
EAST SOUTH CENTRAL
WEST SOUTH CENTRAL
MOUNTAIN
PACIFIC
365
*738
CONN. ME. MASS. N.H. R.I. VT. N.J. N.Y. PENN. ILL. IND. MICH. OHIO WIS. IA. KAN. MINN. MO. NEBR. N.D. S.D. DEL. FLA. G.A. MD. N.C. S.C. VA. W.VA. ALA. KY. MISS. TENN. ARK. LA. OKLA. TEX. ARIZ. COL. IDA. MONT. NEV. N.M. UTAH WYO. CALIF. ORE. WASH.

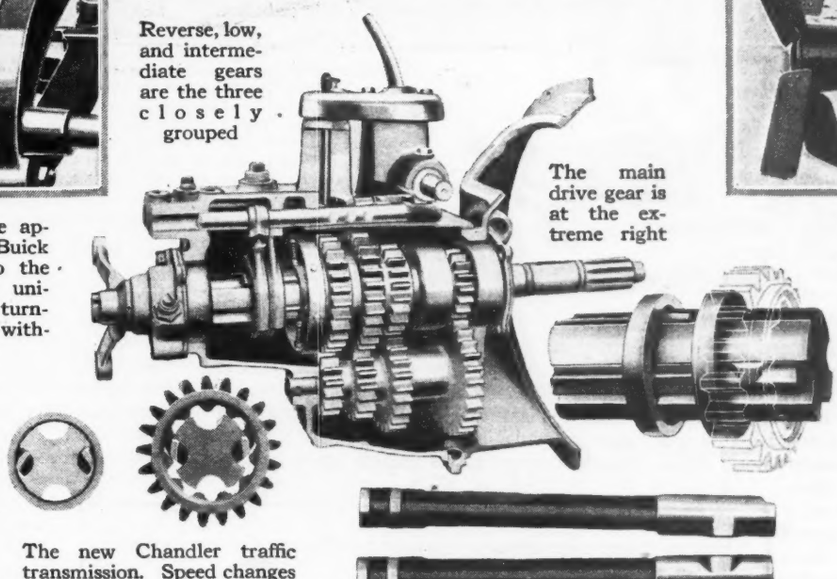
*The figures for Rhode Island and Massachusetts are not comparable with those of other states, since the local basis for census calculations is different. In this chart population figures are based on the 1920 census. Dark lines indicate number of cars in cities; shaded lines, number on farms



Cut-away view of the 1924 seven-passenger Studebaker closed car, showing the new model's roominess



Above is shown the application of the Buick four-wheel brake to the front wheel. The universal joint permits turning the front wheel without affecting the rest of the brake. The Buick brakes are so designed that in turning a corner the brake on the outside front wheel does not operate when the brakes are applied. There are also four external brakes for service work with an extra pair of internal brakes on the rear wheels

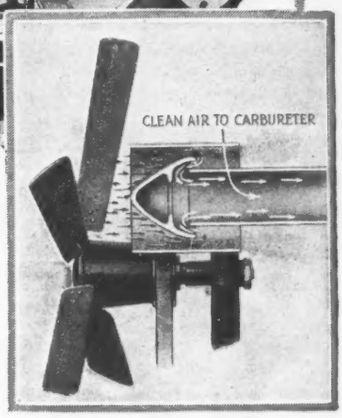


Reverse, low, and intermediate gears are the three closely grouped

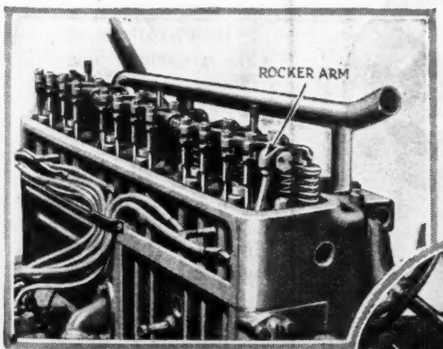
The main drive gear is at the extreme right

The new Chandler traffic transmission. Speed changes are effected through sliding keys that lock gear to shaft. Directly above are two cross section views of the shaft, showing keys in neutral (left) and engaging a gear (right)

Directly above are the rodlike, sliding keys that are moved back and forth in grooves in the main drive shaft to lock any desired gear to the shaft. The upper phantom view shows the assembly of gear, grooved shaft, and key

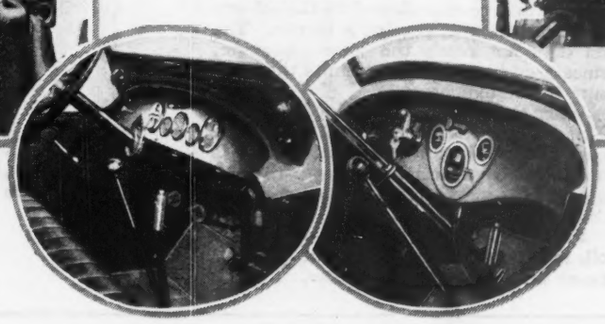


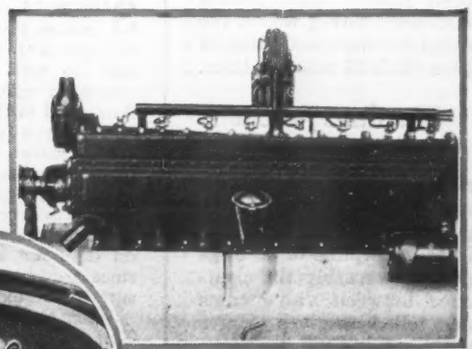
The air cleaner shown above is found on 1924 Rickenbacker models. It is designed to decrease carbon deposits in the cylinders by removing dust and dirt from the air supplied to the carbureter. Incoming air is blown against a cap-shaped head that deflects heavy particles of dirt, while clean air is taken in



The new Buick engine, showing automatic lubrication to the valve rocker arms. This feature assures a smoother running engine. Other engine improvements include double valve springs, new carbureter and detachable motor arms

Closer grouping of instruments on the dash is a noteworthy 1924 tendency. Below are shown two of these groupings—on the Studebaker (at left) and the Dodge (at right). Assembly of the instruments on a small panel enables one bulb to light all instruments





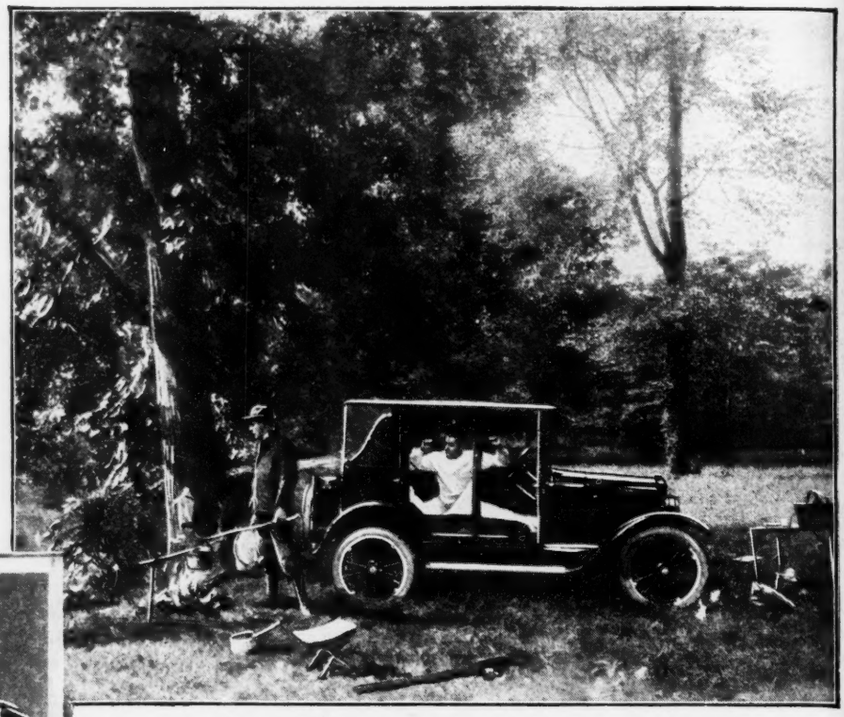
Above is the remarkable new Packard eight-cylinders-in-line engine, showing the simplicity of design and accessibility of parts. While this engine is longer than usual, it does not distort the car's body lines

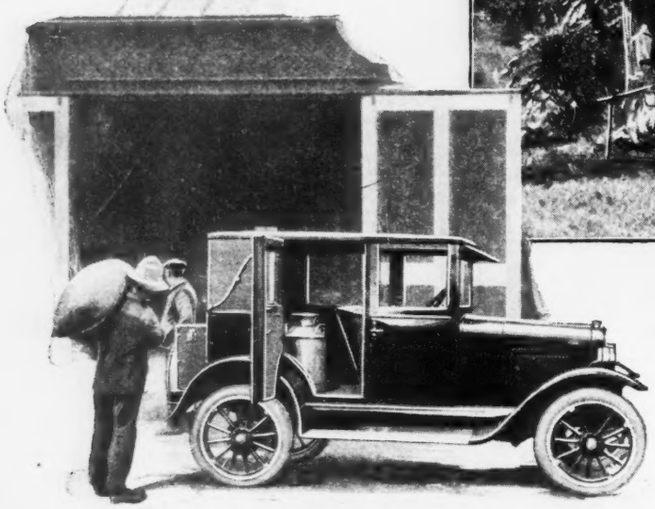
Oldsmobile in its Model 30 Six. Here the cylinder block and crankcase are cast integrally. The motor, with detachable L-type cylinder head, develops more than 42 horsepower. The principal improvement announced by Chandler for its Pike's Peak motor consists of a change in the oiling system, which now is entirely a pressure feed.

In the Buick engine a removable cylinder head has been introduced among other motor improvements.

Some Overland models have a larger motor. The Maxwell has adopted the Kingston oil vacuum system, in which the gasoline is drawn into the vacuum tank through a vacuum induced at the oil pump instead of at the inlet manifold. The advantage claimed for this system is that when the engine runs out of oil the vacuum ceases and the engine stops because no gasoline is fed to the carbureter. This prevents damage to the engine through lack of oil.

The Oakland has a new engine of the L type. In addition, it has changed from a cone clutch to the disk type. For the 1924 Cleveland Six, it is stated that in designing the "extra power motor," emphasis has been placed upon getting maximum power within the usual driving speed range of from 10 to 35 miles an hour.





With removable front and rear seats and spacious compartment, the new Overland Champion is a veritable home on wheels for the motor camper. A full-sized bed can be made up on the floor of the car, as shown above. This remarkable car also is designed to perform an almost endless variety of service for the farmer, from carrying milk tools, seed and supplies on weekdays to speeding the family to church on Sundays and to the movies on weeknights

Two Gears for One

In the Jewett two small non-metallic timing gears replace one large camshaft gear and reduce the possibility of warping of a large gear. Increasing the clearance between valve cams and followers gives quieter valve action. Shorter valve stems are used and bracket guides prevent the misalinement of valves. Oil is drawn from the lowest point of the oil pan so that as long as any oil is in the pan, the engine will be lubricated. Connections of wires on spark plugs have been improved so as to insure better ignition. Main bearings have been strengthened. The starting motor has been redesigned to give better service.

In furnishings as well as in design, the new models are unusually attractive. Nash improvements include more luxurious and comfortable upholstery, clock, smoking set and vanity case combined (in closed cars), larger trunks and rear vision mirrors. The Studebaker has a tonneau lamp with long extension cord, also a courtesy light.

Many devices for comfort and convenience that heretofore have been considered accessories have been added to standard equipment by other manufacturers. Especially noteworthy are trunks and trunk racks. Some of the trunks are built with separate compartments for clothes, dishes, food, and the like. The development along this line has reached the stage where it is possible to carry almost any amount of equipment on the road without sacrificing passenger room.

The Nash is conspicuous in this respect, especially in its Victoria model, which has a commodious built-in trunk.

Hard to Prophesy

I have tried to indicate here something of the definite progress that is evident in the 1924 automotive world.

It has been quite impossible to name all of the new features or all of the different cars that have introduced improvements. And it would be even more difficult to prophesy the many other improvements that are sure to appear during the coming year.

Know Your Car

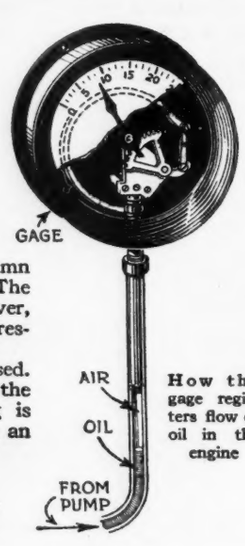
Your Oil Gage

SINCE 75 per cent of all depreciation can be traced directly to improper lubrication, every driver will do well to understand the operation of the gage indicating flow of oil in the engine.

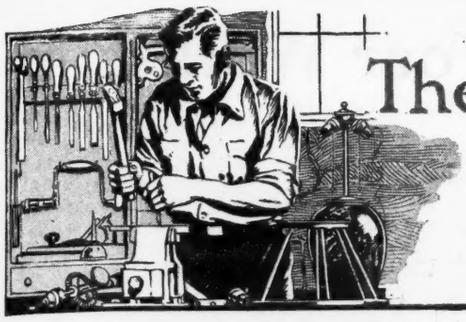
The type gage most generally used is shown here. The lower end is connected with the oiling system near the oil pump. Pressure from the pump is communicated to the column of oil in the tube, causing it to rise. The oil does not reach the gage, however, since a cushion of air transmits the pressure to the indicator.

When the oil rises, the air is compressed. This tends to straighten a bent tube in the gage. The amount of straightening is magnified by means of levers so that an appreciable movement of the dial results.

Plugged pipe, faulty pump, lack of oil, or oil thinned with gasoline will cause the gage to fail to register.



How the gage registers flow of oil in the engine



The Home Workshop

Arthur Wakeling, Editor

One-Tube Radio Set Operates Loudspeaker

By Joseph Calcaterra

Of POPULAR SCIENCE MONTHLY'S Radio Staff

BROADCAST programs from stations 700 miles away are received regularly on a high grade loudspeaker through the simple, inexpensive, one-tube radio set illustrated. They come in clearly enough to be heard in any part of a good-sized room.

The secret of the extraordinary results obtained with this remarkable little set lies mainly in an unusual modification of the familiar single-circuit regenerative hook-up. The primary coil is tapped in such a way that it becomes an auto-transformer with separately and independently adjustable grid and aerial circuits. This makes possible the high efficiency and loud signals of the single-circuit set and at the same time gives the selective qualities of the double or triple circuit hook-up.

Using the set within two miles of the two most powerful broadcasting stations in New York City, I have had no difficulty in tuning either station in and out at will, without any interference, of course, from near-by stations. The signals on the head phones can be heard across the room and the volume is sufficient to operate a loudspeaker.

What is far more surprising, however, is the fact that distance seems to make little difference. With an outside aerial 100 ft. long the set also brings in on the loudspeaker stations WDAP and WJAZ in Chicago.

Add to these characteristics the important features of low cost, easy construction, and simple control, and it will be seen that this set I have evolved from the ordinary single-circuit receiver is one that is certain to give satisfaction in radio reception.

How the selective qualities of the set are obtained is shown in the wiring diagram. The aerial switch can be adjusted to any point on the coil, so also can the secondary switch. One switch being attached to the aerial and the other switch to the ground post, makes it possible to adjust the aerial either on one side or the other of the ground connection and greatly adds to the selectivity. The variable condenser across the grid circuit aids in close tuning.

The number of parts used has been reduced to the minimum. The complete cost of making the set, exclusive of tube, batteries, and head phones, amounted to less than $8. This is based on the use of a homemade variocoupler. If a commercial variocoupler of the $3 type is used, the cost can be held down to less than $10. The panel is 7 by 10 in., a standard size.

In the layout of the parts, shown clearly in the illustrations, *A* and *B* are the aerial and ground posts respectively; and *C* and *D* are ordinary inductance switches with 5 contact points and 2 switch stops each. *E* is a variocoupler having from 50 to 60 turns on the stator and from 35 to 50 turns on the rotor winding.

F is a 23-plate variable condenser of the Vernier type. *G* is the rheostat for control of filament current of the tube, the type used depending on the type of tube. *H* is the tube socket, which also depends on the tube used. *I* is a combination grid leak and condenser. The grid leak should have a value of from 1 to 2 megohms and the condenser a capacity of .00025 mfd.

J, *K*, *L*, and *M* are the terminals and heads of the screws of the binding posts used as phone and battery connectors. Binding posts of the double connector type are convenient to use; if these are not obtainable, ordinary binding posts may be used.

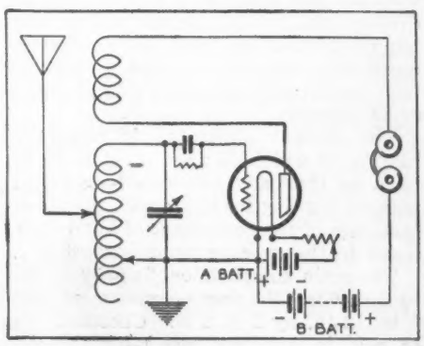
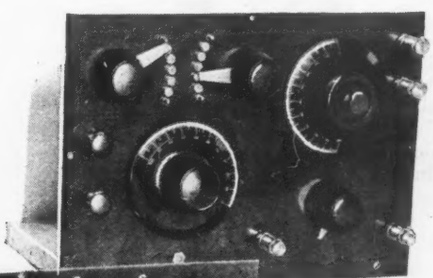
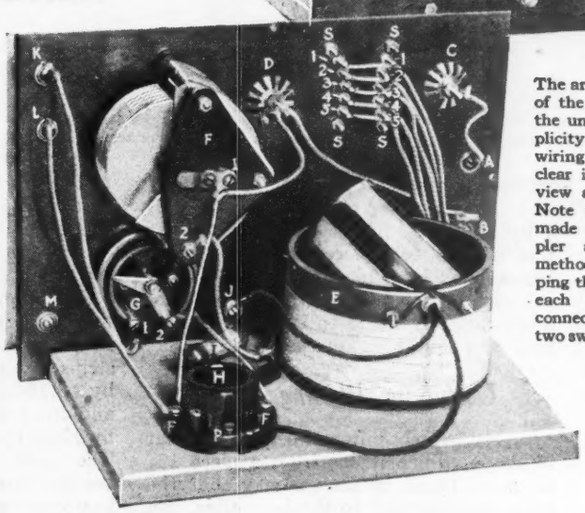


Diagram of the hook-up, which is a modification of the single circuit



The front of the panel (at right) showing the few controls with which great selectivity is obtained



The arrangement of the parts and the unusual simplicity of the wiring is made clear in the rear view at the left. Note the homemade variocoupler and the method of tapping the primary, each tap being connected with two switch-points

The cost of the parts will vary slightly in different localities. The variocoupler should not cost more than one dollar if made at home and a satisfactory commercial coupler can be bought for $3 or less. A dial will cost about 30 cents.

A good socket can be had for from 50 to 75 cents. A suitable rheostat will cost 30 cents and a grid leak and condenser about 60 or 70 cents. A variable condenser with vernier can be obtained for $3. The switches, switch contacts, and binding posts will add another dollar to the cost. From $1 to $1.25 will cover the cost of the panel.

Making the connections is a simple matter. First connect the top end of the stator winding with one terminal of the grid condenser and leak and with the stator plate terminal No. 2 of variable condenser *F*. The other terminal of the grid condenser and leak is connected with the *G* terminal of the socket.

The No. 1 switch contacts of both switches should be connected with the first tap from the top end of the stator winding; the No. 2 switch contacts should be connected with the second tap of the winding, and so on down to the last switch contacts and taps.

The aerial post is next connected with the arm of switch *C*. A wire is run to connect the ground post, the switch arm of switch *D*, the rotary plate terminal No. 1 of condenser *F*, one of the *F* terminals of the socket, and the binding-post terminal *L*.

Binding post No. 1 of rheostat *G* is con-

(*Turn to page 109*)

Three Ways of Improving Your Workshop

How to Make a Wall Tool Cabinet, a Bench Hook, and a Boring Gage

AS THE home worker adds to his collection of tools, the problem of keeping them in order and at the same time instantly available for use becomes more pressing. To leave them scattered about the bench is hard on the tools and harder on the temper; yet if they are put away in a box or even in drawers, they are not so accessible. The happy solution is a wall tool cabinet of ample size, and this the home worker can build for himself with little difficulty and small expense.

The cabinet illustrated is especially roomy. It will hold a set of at least 50 tools so that any one can be selected without hunting for it. It will, therefore, take care of the equipment of hand tools found in the average home workshop.

The main compartment is 6 by 24 in. by 2 ft. 6 in.; the door compartments are 5 by 12 in. by 2 ft. 6 in. Chestnut or oak is excellent wood for the cabinet, but the builder can use other woods if he prefers.

The stock for the tops, bottoms, and sides is ⅞ or ¾ in. thick; that for the shelves and drawer fronts, ⅝ in.; that for the back of the cabinet and the front of the doors, ⅜ in. (solid or 3-ply); that for the sides of the drawers, ½ in., and for the backs and bottoms of the drawers and for the sliding tray, ¼ in.

The type of joint illustrated is strong and workmanlike; but simpler joints can be used, such as a plain rabbeted joint or even a butt joint. The corners are greatly strengthened by the use of angles bent from brass, 8 of them being made from pieces 1/16 by 3½ by 5 in. and 4 of them 1/16 by 3½ by 6 in.

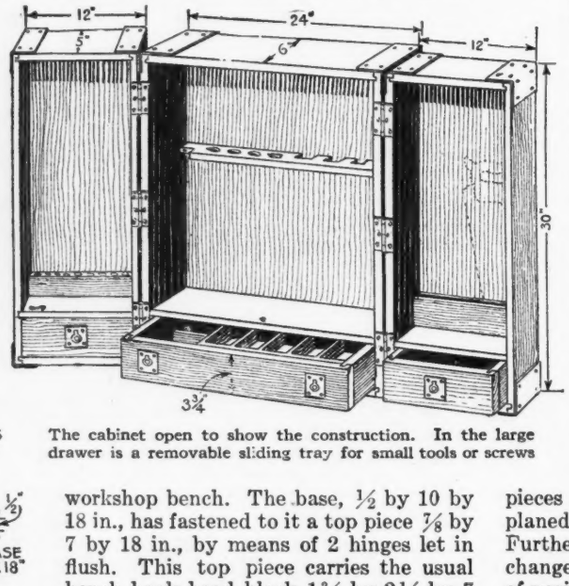
Other hardware necessary is six 3-in. narrow brass butt hinges, 4 flush ring pulls, a hook and eye or elbow catch, a cupboard lock and escutcheon, and hooks and clips for tools as desired. Commercial tool clips can be used, metal clips made, or wooden racks provided in the way shown.

This cabinet was designed especially for POPULAR SCIENCE MONTHLY by George F. Kaercher, who has been superintendent of several of the largest woodworking plants in the United States. The working details and complete bill of materials, which are contained in Blueprint No. 30 in the Home Workshop series, will be sent to any reader for 25 cents.

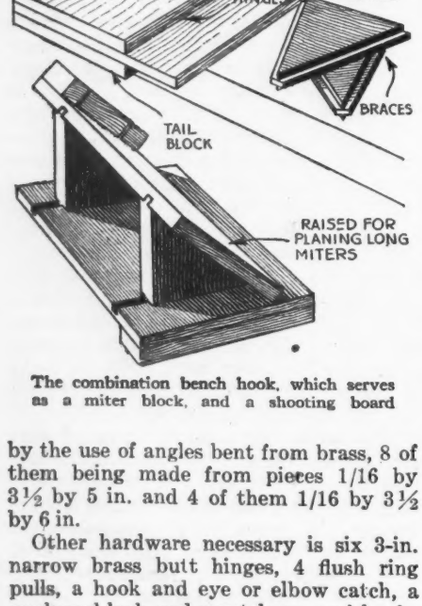
On the same sheet are details of two other extremely useful bench fixtures for the home worker.

One is a unique combination bench hook, miter block and plain, miter, and the long-miter shooting board. This ingenious fixture could well replace the ordinary bench hook on every home workshop bench. The base, ½ by 10 by 18 in., has fastened to it a top piece ⅞ by 7 by 18 in., by means of 2 hinges let in flush. This top piece carries the usual bench hook head block 1¾ by 2½ by 7 in. with 2 miter cuts, which should be most carefully made to insure the accuracy and squareness of the miters.

Each tool in a set of 50 or more is instantly available when kept in this compact and useful wall cabinet



The cabinet open to show the construction. In the large drawer is a removable sliding tray for small tools or screws



The combination bench hook, which serves as a miter block, and a shooting board

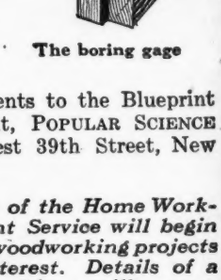
Useful for Planing Rules

A removable miter block, triangular in shape, which is cut from a piece 1¾ by 5 by 10 in. in such a way that the grain runs parallel to the long edge, can be fastened to the bench hook when necessary by means of dowels. The dowels are glued in the miter block and fit snugly into holes in the top piece of the bench hook proper. This attachment is for planing the ends of miter cuts such as in making picture frames or preparing moldings to be mitered around cabinet work, as in the sketch in the upper right-hand corner.

There is still another use for the fixture. That is when long miters have to be planed, as sometimes in cabinet work involving long mitered joints. The whole upper part of the bench hook is swung up on the hinges and supported at 45 degrees by means of two triangular blocks. These blocks have tongues that slip into grooves, as shown. The edges of the stock can then be trued up most accurately by "shooting" them with a fine-set plane.

The other fixture illustrated is a gage for boring holes for dowels or preparatory to cutting mortises. The ordinary wooden gage of this type is difficult to make because the hole through it must be bored with absolute accuracy. There is nothing difficult in making the gage shown, however, for the hole is formed not by boring, but by means of two thin wooden pieces and two spacer blocks that can be planed true and square before assembling. Furthermore, it is a simple matter to change the blocks for use in boring holes of various sizes.

The dimensions suggested as being most generally useful are as follows: Main block ⅞ by 2½ by 4⅜ in.; division strips ⅜ by 1 1/16 by 2 3/16 in.; back and front caps ¼ by 2 3/16 by 2½ in. The four screws are No. 18 or other heavy screws 2 in. long with the points cut off.



The boring gage

If you wish the sheet of details for the cabinet and the two bench fixtures, send 25 cents to the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York.

THE third year of the Home Workshop Blueprint Service will begin next month with woodworking projects of exceptional interest. Details of a Priscilla sewing cabinet will appear next month.

Contest Winners Name Most Useful Tools

THE first prize of $25 in POPULAR SCIENCE MONTHLY'S recently concluded contest on the subject, "The Most Useful of My Tools," is awarded to Maj. R. S. Bamberger, of 1016 Sixteenth Street, N. W., Washington, D. C.

For many years an army officer, Major Bamberger has made working with tools his hobby. Frequent changes of station, however, have compelled him to limit his equipment to a few of the most useful tools, and in emergencies he often has had to adapt the tools at hand to rather novel uses. Most versatile of all he finds his pliers, as he explains in his prize-winning contribution, which follows:

I AM just an every-day amateur with a little mechanical ability and a great love for tools. While I love them all, I have absolutely no hesitation about picking out what, to me, is the most useful one—my slip-joint pliers. It would be much easier to tell you what I have not done with them than what I have used them for.

Of course, they have their legitimate uses, but I'm simply going to mention a few of the odd ways in which they have come in mighty handy. Your hammer isn't at hand—use your pliers. One end of the grip is a fine screwdriver and by extending the other end at right angles, enormous leverage in driving or taking out screws is obtained. As a pipe wrench on small stock I get splendid results. I have used it as a monkey wrench and as a tap wrench.

It is a good pin vise; laying the handles between the jaws of a bench vise, the jaws of the pliers will hold any piece of irregular stock; it is a splendid nail puller; I use it to bite off longitudinal pieces of small wood stock; wire is cut easily by using it on the shank of a screwdriver, any screw may be driven, or, if rusted in, screwed out. The handle takes out close driven tacks.

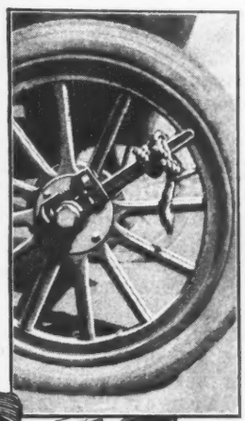
I have used it as a come-along; it opens screw tops like magic; it bends metal readily; when I can't find a corkscrew (for vinegar bottles only), I insert a screw in the cork and then pull the screw out with the pliers—the cork comes with it; it takes the place of the mislaid can-opener; in cans that open with a key, whenever the metal strip breaks (and it usually does), the pliers finish the job; it skins insulated wire; the handle acts as a lever in inserting screweyes and in lifting refractory windows; I have opened butt hinges on a locked closet door when the key has been lost.

This letter could have been shortened by saying that I use it for everything; as a matter of fact, I am as careful to see that my pair of pliers is in my grip when I am starting on a trip as I am to take my toothbrush along.

Now you can see why, without hesitation, I call the slip-joint pliers my most useful tool.

The winner of the second prize of $15 is W. S. Branaman, of 821 North Lawrence Avenue, Wichita, Kans.

His first experience with tools was in helping his father build a sod shanty on a claim in Kansas 60 miles from a railroad. Cowpunching and country school divided his attention until the lure of mechanics drew him into carpentry work. Now he is general delivery clerk in the Wichita post office and has a carpenter shop at home where he does all kinds of fancy cabinet work for amusement. Incidentally, he finds it a profitable pastime.



Maj. R. S. Bamberger, first prize-winner, is shown above using his pliers to help turn a stubborn screw. W. S. Branaman (at the left), who won second prize, is tightening a wire fence strand with his hammer. The third prize-winner, James Gary, used a pipe wrench as shown at the right to save himself from being stalled on an Arizona desert

Mr. Branaman's contribution to the contest is as follows:

I WOULD say the clawhammer is the most useful of any tool I have. It is the only tool you can use successfully to drive all kinds of nails, from a half-inch brad to a fortypenny spike. In using finish nails and in doing any fine work, no tool will take its place. In pulling all kinds of nails, the same rule applies. Nothing will take its place.

In taking up an old floor or laying a new one, in taking off an old roof or laying a new one, the hammer is all you need to do the job.

If I am laying brick or stone, I use the hammer to break them. If I am making ice-cream, I use the hammer to break the ice.

In taking down any kind of a frame structure, I use the hammer to loosen all joints and pull all nails.

If I want to half sole a pair of shoes, I use the hammer. With the hammer and a nail I can set a saw. If I break or bend a nail in driving it, the hammer is the only tool to take it out successfully.

I can stretch a barbwire fence with the hammer. Just catch the claws over the wire at a barb and get a leverage around a post; you can then make it very tight. You can also cut a wire or a nail with the claws of the hammer.

If I am plowing and bend a share, I take the hammer and a piece of flat iron and straighten it out. I can take a piece of red hot steel and hammer it out to make a chisel.

If I have a bucket, tub, or pan with a dent in it, I pound it out with my hammer. In putting up any frame structure you must have a hammer all the time. To put up a brace or take one down, you must have the hammer to do it.

In going out late at night if I feel I need some protection, I just stick the handle of the hammer inside my belt, the claws catching over the top of the belt. It makes a handy and good defender.

James Gary, of Maricopa, Ariz., is the winner of the third prize, $5. He is another reader of POPULAR SCIENCE MONTHLY who makes a hobby of his home workshop, specializing on toys and small models. He also does all his own auto repairing.

The letter of Mr. Gary is as follows:

YOUR prize offer for a letter on which tool I like best prompts me to say that all tools come in handy at times, but I use my pipe wrench most of all.

If a hub cap on the car gets smashed up so badly that it is impossible to take it off with an ordinary hub wrench, I use my pipe wrench. It makes it come off in a hurry.

I have used the wrench to take off fruit-jar tops that would not come off in any other way. It can be used to fix up pipe fittings around the house and the well. I have used it to take off the radiator cap of my automobile when it was too hot to handle with bare hands.

There are a lot of other uses for a pipe wrench, but I won't mention them here or my letter will be too long. Instead, I will tell about the most important use I ever had to put my pipe wrench to—a use that saved me from being stalled in a desert.

One day, after being over to Phoenix, Ariz., which is about 35 miles from my town, I was on my way home and had

(*Continued on page 118*)

Secrets of Wood Carving

By Joseph Coudon

Instructor of Woodworking, U. S. Veteran's Hospital No. 81

WHY more home workers do not use simple woodcarving to ornament their handiwork is a mystery to me.

If it is because the tools are elaborate and costly, let me tell you about my own set of tools for shallow carving made at no expense whatever from old power hacksaw blades and a file or two. If it is because the work seems too difficult or tedious, let me explain how it can be done with reasonable ease and speed.

Suppose you have a pair of plain walnut bookends (walnut, mahogany, oak, gum, and similar hard woods are better for carving than the softer woods) and wish to carve a rosette or circular ornament in the center of each. Probably the simplest type of rosette is one that is chip-carved—made by removing triangular slivers with a sharp knife, to form sparkling geometrical patterns as shown in Fig. 2.

The knife can be a regular chip-carving knife for manual training work sold at hardware stores, a ¼-in. skew carving chisel, or a chisel made from a machine hacksaw blade. I prefer the shape shown in the second tool from the bottom in Fig. 5.

With compass, square, rule, triangle, and pencil, lay out on the wood one of the simpler rosettes suggested by Fig. 2 and then carve it by making vertical, rocking cuts into the wood to mark the deep points and slanting or paring cuts to remove the triangular chips.

Little more difficult than chip carving are line carving and ribbon carving. The former is merely a geometrical design marked out with a veiner or deep 1/16-in. gouge. All lines are begun inside the corners and finished toward the corners. Ribbon carving is somewhat similar, but the lines are broader and are formed by means of a vertical cut on one edge and a slanting cut made to join it from the other edge—like elongated chip carving.

Next comes the useful type of carving shown in Fig. 3. In this the background is first outlined, just inside the lines, with a deep ¼-in. gouge, using it like the veining tool in line carving. Then the background is cut out or grounded with parallel cuts across the grain made by the same tool held on its side, and the vertical edges are trimmed with whatever gouges and skew chisels are at hand. Whenever possible, use a gouge that fits the curve, as fiddling the work with a number of small cuts is the principal error made by beginners. Shallow bent gouges, if available, are used for truing up the background.

The background also can be indented, if desired, with designs made by punch-like carvers' markers, obtainable in many styles, or by a large nail, the point of which is filed flat and then filed deeply in crisscross or checkerboard fashion.

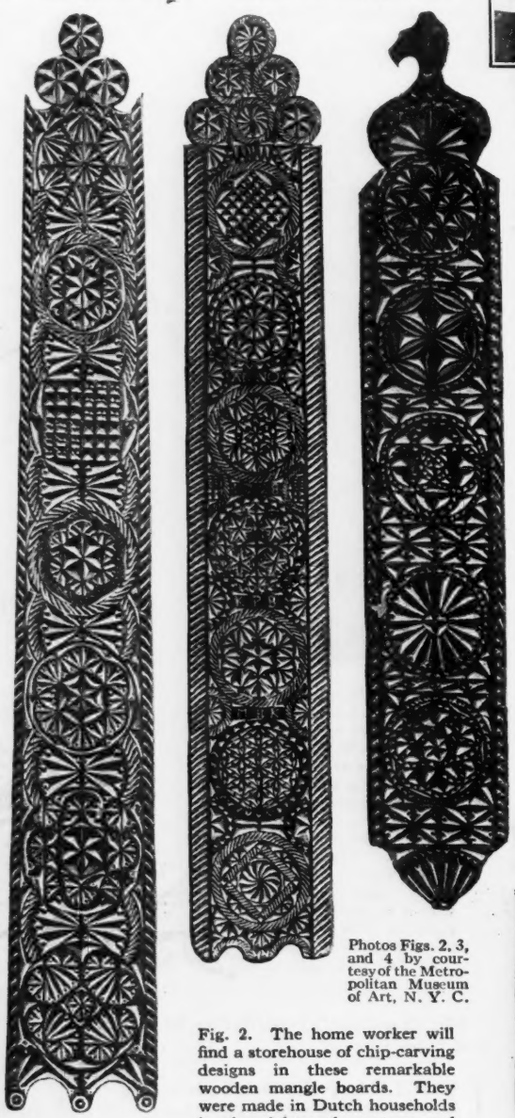
From this stage, it is not difficult to elaborate the carving in two more ways. One is to carve or model the face of the design, as shown in Fig. 4. The other is to carve the vertical edges, where the design sinks into the background, with a molding, as in the Gothic tracery in churches.

Keeping your tools sharp is half the battle. They are sharpened in the same way as other woodworking tools, but on both sides. After they are ground, the finishing is done on an oilstone and with carvers' slips—small stones with the edges shaped to suit various gouges and V-tools. The tools are then stropped on leather.

The first four tools below are made from hacksaw blades; the last is a 6-in. double end, slim taper three-square file, each end ground at an angle. Handles could be fitted to these, but I prefer them without.

For those who wish to buy a set of tools, I suggest ⅛- and ⅜-in. straight chisels, ¾- and ½-in. straight shallow gouges, a 5/16-in. bent shallow gouge, 1/16- and ¼-in. straight deep gouges, a ¼-in. skew chisel, and a ⅛-in. parting tool.

Fig. 1. Elaborate carving in Italian style executed by boys in a woodworking class at Greenwich House, New York City



Photos Figs. 2, 3, and 4 by courtesy of the Metropolitan Museum of Art, N. Y. C.

Fig. 2. The home worker will find a storehouse of chip-carving designs in these remarkable wooden mangle boards. They were made in Dutch households in the eighteenth century and required no tools but a knife

Fig. 3. Two American pieces carved prior to 1700, one a panel from an oak chest with tulip design, the other a desk box of oak and ash

Fig. 4. The simple grounded carving of Fig. 3 may be developed into the modeled carving shown at left

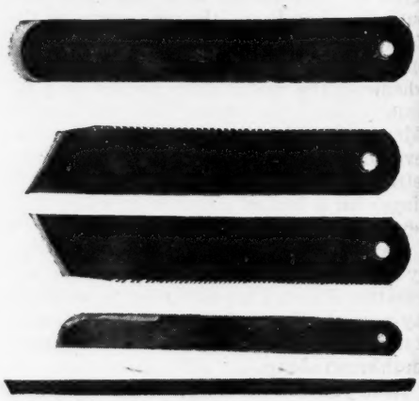
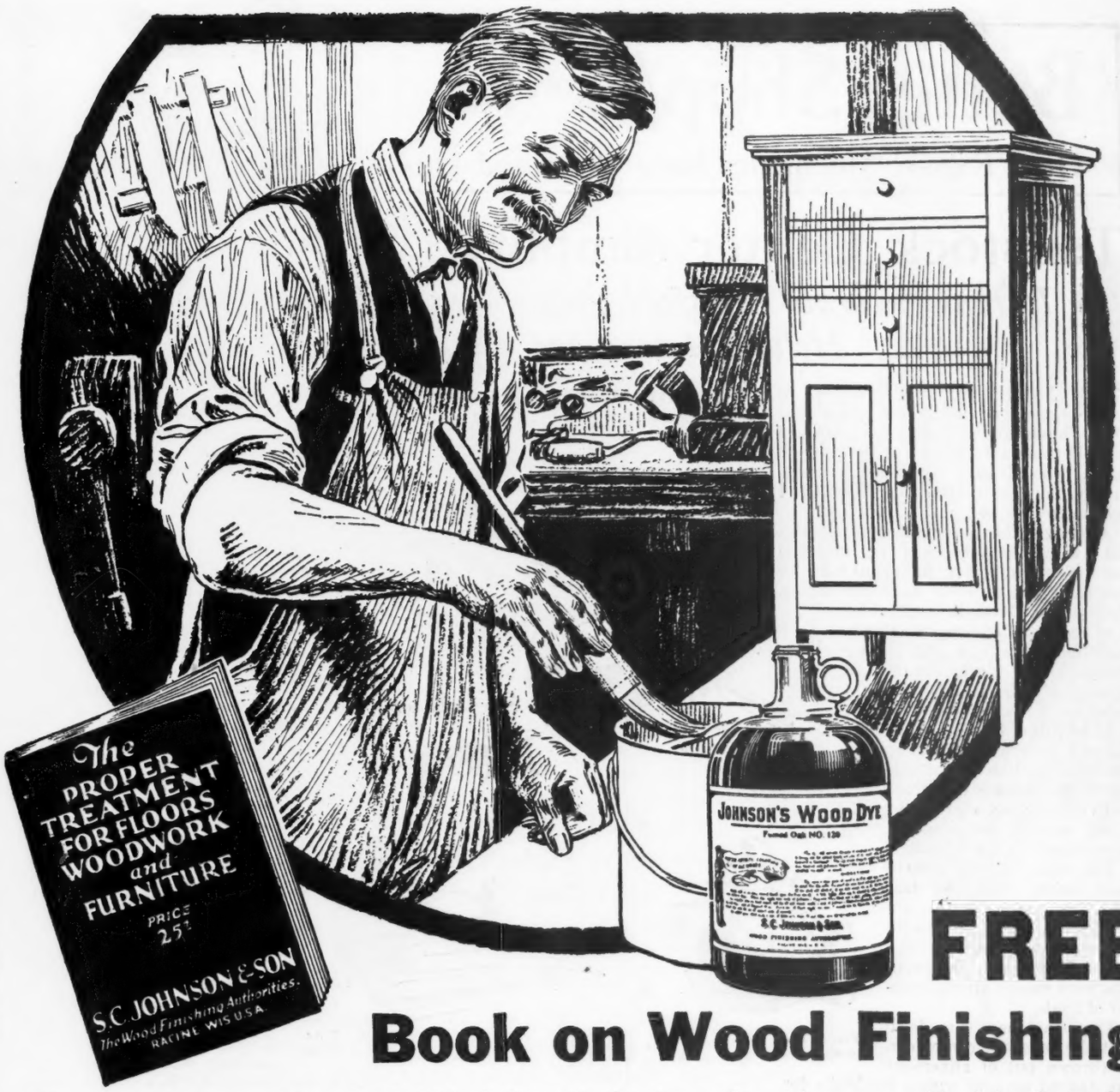


Fig. 5. These five tools are part of a set used by Mr. Coudon for shallow carving such as he has described in the instructive article above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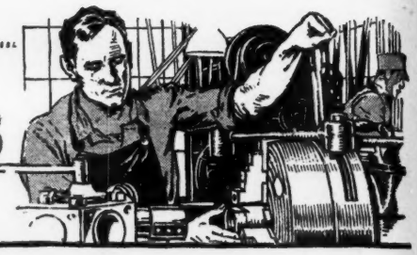

Tailstock Center Simplifies Taper Turning

It Has Accurate Crossfeed Adjustment and Attachments for Holding Lathe and Boring Tools

By B. R. Wicks
Engine and Machine Designer

TO SIMPLIFY the turning of tapers, especially on lathes that have no thoroughly accurate and reliable taper attachment of the conventional type, I have developed a taper-turning tailstock center along lines that I believe are unique.

Although the accompanying illustrations show the attachment as designed for small work, it is by no means a device limited to the amateur mechanic with a cheap lathe. Made in larger sizes, it will be found of especial value in machine shops and auto repair garages where a large—in fact, an increasingly large amount — of taper work has to be done.

In addition, the device has boring and turning heads, simple in construction like the attachment itself, but flexible in adjustment and valuable to a degree that will, I feel certain, be generally appreciated by machinists.

The need for the attachment arises from the fact that not all lathes are equipped with taper attachments and some that do have them will not turn out accurate work except after a number of trials.

The attachment is made so that the tailstock center can be thrown out of alinement any desired amount within the limits for which it is designed. This can, of course, be done by setting over the tailstock itself, but the inconvenience comes in placing it back accurately in line. With the taper-turning center this difficulty is eliminated; simply by turning the feed screw until the indicator reads zero on the scale, the center is again alined.

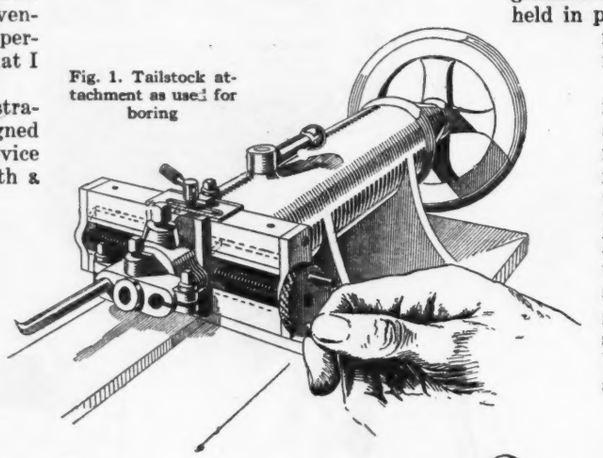

Fig. 1. Tailstock attachment as used for boring

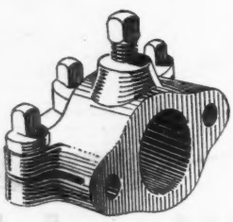

Fig. 2. The boring head

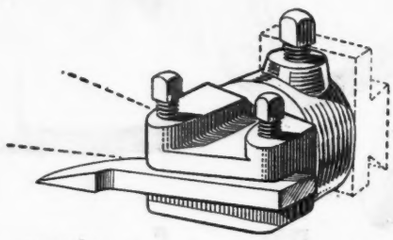

Fig. 3. The turning head

How the Slide Is Machined

The slide forms the main part of the attachment. A rectangular block of machine steel is finished as shown in Fig. 4, with a tapered shank to fit the lathe tailstock. The slide is dovetailed to receive the taper center and the boring head, a gib being used at the top of the dovetail slide to transmit the pressure from the binding screw so as to clamp the head in position after it has been set by the feed screw.

The feed screw extends from the hand wheel entirely through the slide and rests in bearings screwed to each end. By turning the wheel the screw forces the movable center horizontally along the slide to any desired position, as indicated by its location with respect to a scale fastened to the top of the slide. The graduated scale, made of tool steel, is held in place by means of a clamp that is screwed to a bracket in the rear of the slide.

Care must be taken in squaring and alining the parts. The angles of the slot in the slide must be true 30 degrees. The feed screw, the tapped hole in the center head, and the two end bearings must be accurately in line. The gib is used to take up the side play of the center head and is adjusted by means of four gib screws situated on top of the slide. The center head is locked by means of a gib thrust block and binding screw.

The shank that is to fit the taper in the tailstock sleeve must be a tight fit, and must keep the slide square with the center line.

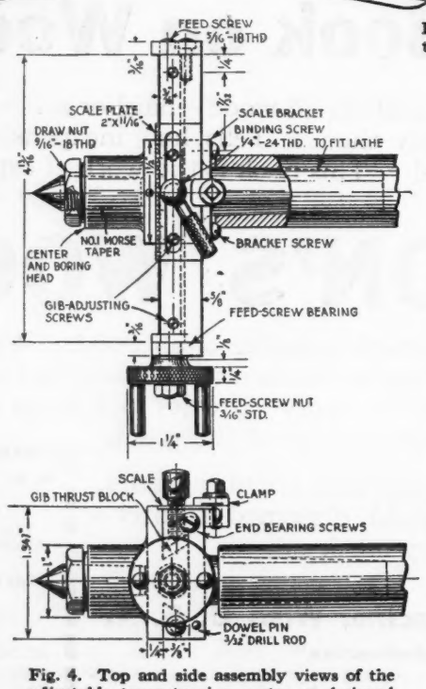

Fig. 4. Top and side assembly views of the adjustable taper turning center as designed for a small lathe, with important dimensions

Feed Screw and Scale

The feed screw is cut left-hand and the center head, if made the size indicated, is tapped out halfway with a 5/16-in. 18-thd. left-hand tap. The scale is made from an ordinary 6-in. standard scale that is not hardened. It will have to be planed or ground to 11/16 in. wide so that it will fit between the bracket and center head. The ¼-in. slot in the scale is intended to allow clearance for the binder.

A thread is cut in the nose of the center head to receive the draw nut that holds the center in place. This is removed when the auxiliary attachments are used.

These boring and turning attachments are castings finished as shown in Figs. 1, 2, and 3. The first has three positions for the boring tool—one in the center and one at either side. A setscrew holds the tool when placed in the center position. When in the other positions, the tool is held by clamping together the slotted projections with the clamping screws provided. A setscrew holds the attachment on the center head projection.

The turning tool holder, Fig. 3, also fits on the nose of the center head. The fixture holds the tool horizontally at an angle with the plane of the slide. Setscrews are provided to clamp the tool in position.

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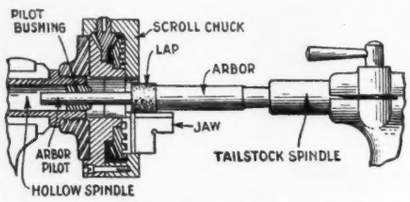
One end of the arbor is turned to fit a pilot bushing, which in turn fits into the hollow spindle of the lathe. This bushing is bored after it is in place so that it will be



The lapping compound is placed on an arbor supported by a pilot bushing and the tailstock

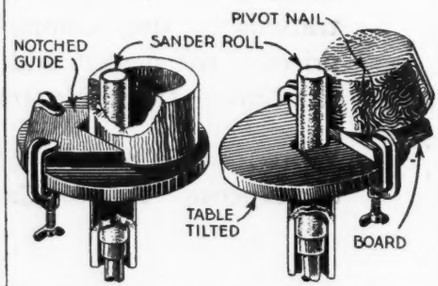
accurately centered. The other end of the arbor fits into the tailstock spindle.

A portion of the arbor, left larger than the rest, is used as the lap. This is covered with oil and emery and brought into contact with the jaws and fed in and out by means of the tailstock spindle. Since both jaws and lap wear away, it will be necessary to bring the jaws into contact with the lap by tightening them.

Soft steel should be used for the arbor and care must be taken not to let any abrasive get into the pilot bushing.

Shaping Conical Wood Patterns on a Vertical Spindle Sander

HOLLOW and conical wood patterns can be made without excessive lathe work by utilizing a vertical spindle sander as shown. The wood is bandsawed to within 1/8 in. of the proper diameter. Then, for inside work, a crotch is clamped to the table in such a position that the sander will just bear against the surface



Finishing the inside of a pattern (at the left) and shaping a conical surface (at the right)

of the wood. The cylinder is turned around the sander roll until the entire circumference of the pattern has been finished.

For outside conical or cylindrical work a board is first clamped to the table, which may be horizontal or tilted. In the board is driven a pivot nail projecting parallel to the sander and at the proper distance from it. A hole is then drilled in the pattern to receive the nail. As the pattern is turned about its pivot, the outer surface is accurately trimmed. Both methods are useful in making patterns for cone pulleys.

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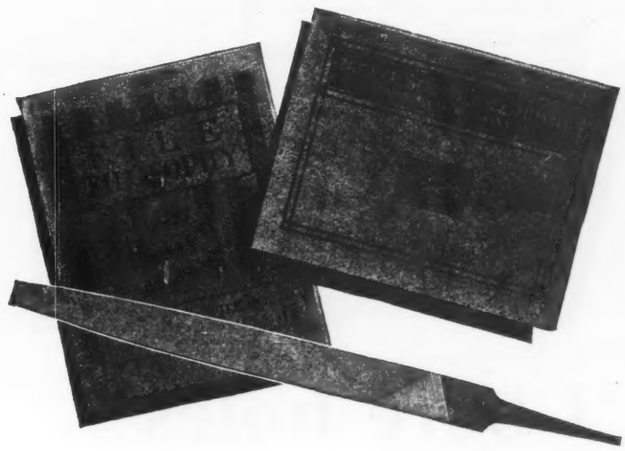

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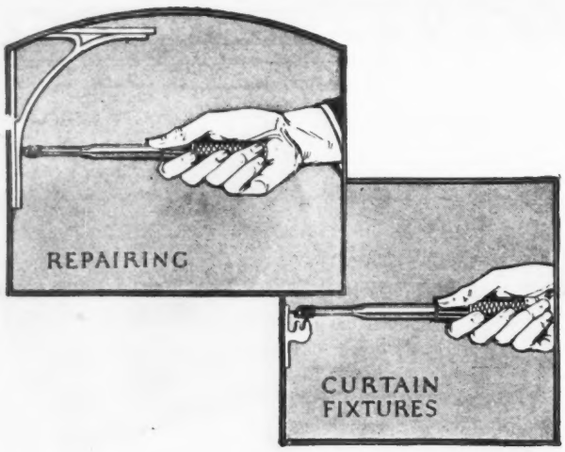

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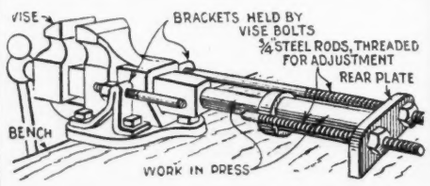
Using the Bar of a Vise as a Press for Bushings

A BUSHING press attachment for an ordinary vise is a useful fixture for work too large to be pressed directly between the vise jaws.

Two brackets are secured to the vise base, as shown. Two long rods pass



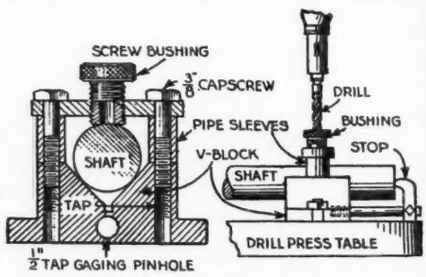
A fixture for the rear of the vise that extends its usefulness in small press work. One rod is shown broken out for clearness

through these brackets and through a rear plate.

The two rods are so placed that the center of the rear plate is in line with the vise bar. Work is placed between the plate and the end of the vise bar and pressure is brought to bear upon it by closing the vise.—G. A. L.

Drill Jig Used with V-Block

DRILLING centrally located holes in round stock is made easier if a drill jig is added to the usual open V-block. A plate is drilled, bored, and threaded, as shown, to receive a knurled drill bushing. The plate is held down on the hook by



A drill jig with a removable bushing is added to a V-block for drilling shafts and round stock

two cap screws, which pass through pipe-sleeve spacers.

The bushings are tool or machinery steel, casehardened. When one is worn too large, it can be annealed and reamed to the next larger size. One end of the V-block is tapped for a gage stop rod for locating the longitudinal position of the hole to be drilled.—J. R.

Shop Features for February

TO DRESS the wheel of a surface grinder at an angle by hand is a tedious job and one that no machinist relishes. A simple fixture for doing the work accurately without waste of time will be described next month in the Better Shop Methods Department.

Another valuable article will tell how to make a set of surface plates.

A non-slip attachment for automatic screwdrivers, a convenient gas shut-off for the shop blower, a slip pulley and gear for preventing tool breakage on automatic machines, and other labor-saving devices will be described by experts.

Equal to All Demands

This is Number Four of a Series

Every tube you add to your receiver makes it just that much more important for you to use Eveready "B" Batteries, for each additional tube increases the work the "B" battery has to do. It demands a more capable, long-lived battery.

Here is a table that shows just what each type of receiving tube draws from your "B" battery. The current is measured in milli-amperes, or thousandths of an ampere.

Current (in milli-amperes) Taken from the "B" Battery by Various Tubes

"B" Volts	WD-11 WD-12	UV-199 C-299	UV-201 C-301	UV-201-A C-301-A
22½	0.5	0.5	0.5	0.5
45	1.5	1.4	1.5	1.5
67½	2.5	2.4	2.5	3.5
90	4.5	4.0	3.9	6.0

Above figures are at zero grid bias

The table shows that the "B" battery current drain increases much more rapidly than the increase in voltage. For example, if the voltage doubles from 45 to 90, the current drain increases three-fold in one case and four-fold in another case. This all means that the life of the "B" battery may be materially lengthened by not using a higher voltage than is necessary to obtain the desired results.

The most popular type of receiver today has at least three tubes, operating a loud-speaker. As ordinarily employed, it places a fairly heavy drain on the "B" battery.

Under light and heavy service, Eveready "B" Batteries prove up. More and more fans buy them every day because they are the most economical. According to the work they have to do, so is their life.

You get most energy for your money in Eveready "B" Batteries—*they last longer.*

"the life of your radio"

The Metal Case Eveready "B" Battery, No. 766. The popular 22½-volt Eveready Battery in a *new* handsome, durable, waterproof metal case. At all dealers, $3.00.

Eveready "B" Battery No. 767. Contains 30 large size cells, as used in the popular No. 766. Voltage, 45. Made especially for sets using detector and one or more stage of amplification. The most economical "B" Battery where 45 volts are required. At all dealers, $5.50.

Eveready Radio Battery No. 771. The Eveready "Three." The ideal "C" Battery. Voltage, 4½ — three terminals permitting the use of 1½, 3, or 4½ volts. The correct use of this battery greatly prolongs the life of the "B" Battery. At all dealers, 70 cents.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, Inc.
Long Island City, N. Y.

EVEREADY
Radio Batteries
—they last longer

Note: This is Number 4 of a series of informative advertisements, printed to enable users to realize the utmost in battery economy. If you have any battery problem, write to **G. C. Furneses, Manager, Radio Division,**

NATIONAL CARBON CO., Inc.
116 Thompson Ave., Long Island City, N. Y.

Ask for special booklets on "A," "B" and "C" Batteries.

"Here's the panel I want"

The panel is the "front door" of your radio set. The selection of the panel is an important step. You want a good-looking panel. And you want a panel that has high dielectric strength.

Your Celoron panel comes wrapped in a dust-proof glassine envelope. Dust and grit cannot scratch it. Human hands cannot leave greasy finger prints on it.

Because of its high dielectric strength, Celoron is approved by the U. S. Navy Department Bureau of Engineering and the U. S. Signal Corps.

Celoron radio panels are finished in black, oak, and mahogany. They come ready to use in these standard sizes:

1...6 x 7 x 1/8 — 5... 7 x 18 x 3/16
2...7 x 9 x 1/8 — 6... 7 x 21 x 3/16
3...7 x 12 x 1/8 — 7... 7 x 24 x 3/16
4...7 x 14 x 3/16 — 8...12 x 18 x 3/16
9...7 x 26 x 3/16

Other sizes are cut to order from sheet Celoron. *Ask your dealer.*

An interesting booklet for the radio set builder is "*Getting the right hook-up.*" This booklet is sent free upon request.

To radio dealers: Send for special dealer price list showing standard assortments

Diamond State Fibre Company

BRIDGEPORT (near Philadelphia) PENNSYLVANIA

Offices in Principal Cities

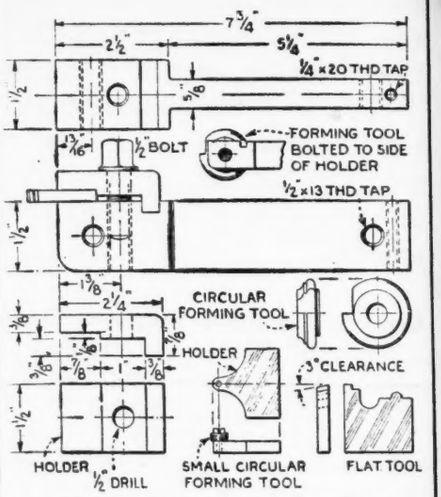
In Canada: Diamond State Fibre Company of Canada, Limited, 245 Carlaw Avenue, Toronto

CONDENSITE
CELORON
STANDARD RADIO PANEL

Flat Forming-Tool Holder Will Be Useful in the Shop

THE forming-tool holder illustrated will be found useful in almost any toolroom where forms and models must be made with great accuracy and be duplicated from time to time. The construction of the holder is obvious from the details, but a word may be added in regard to the tools made for use with it.

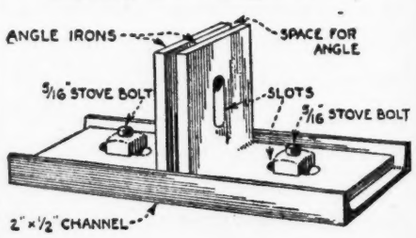
The forming tools are made of flat tool steel and are shaped either to fit a model or made up to suit the drawing. The various radii should be stamped on the tools before they are hardened, as well as the name and number of the model or drawing they are intended to be used with.



Details of the tool holder and several types of forming tools used with it

After the tool or set of tools has been used, it should be turned into the model or toolroom crib and stored for future use. The tools will last indefinitely when they are called for only occasionally, as is frequently the case, but an accurate record should be kept so that it is always possible to tell what tools are on hand. Circular forming tools can be sharpened without changing their form.

Bench Fixture Saves Time in Laying Out Angle Irons



WHEN laying out small angle irons, difficulty is often found in holding them in place so the flat surface will be up.

A simple bench fixture can be rigged up to do this by fitting two pieces of 4 by 3 by 5/16-in. angle iron into a 2 by ½-in. channel, 9 in. long. The slotted holes in the legs allow adjustments to be made to accommodate angle irons of varying thickness. — O. W. MIELENZ, Philadelphia, Pa.

How To Make Things Electrical

This book gives directions for making hundreds of electrical appliances and devices for the home, the shop and the garage. The simple directions and many drawings make the work easy.

429 pp. Price, $1.50 postpaid

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POPULAR SCIENCE MONTHLY
225 WEST 39th ST., NEW YORK

Radio Catalogue Free—

Write us a post card—
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and we will send you free this 52 page catalogue of radio sets and parts. It also contains explanation of radio terms, map and list of broadcasting stations and much radio information, including an explanation of successful hook-ups and circuits.

You will be amazed at the low prices Ward's quote. A complete tube set having a range of 500 miles and more, including tubes, head set, batteries, and antenna equipment, as low as $23.50.

This catalogue contains everything for the expert and amateur. Complete sets and every improved part for building sets, all the most up-to-date devices—at the lowest possible prices.

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Montgomery Ward & Co. is headquarters for Radio, selling everything direct by mail without the usual "Radio-profits." Why pay higher prices? Ward quality is the best and the prices will often save you one-third. Everything sold under our Fifty Year Old Guarantee,—Your Money Back if You Are Not Satisfied. Write today for your copy of this complete 52-page Radio Book.

Write to our house nearest you. Address Dept. 5-R

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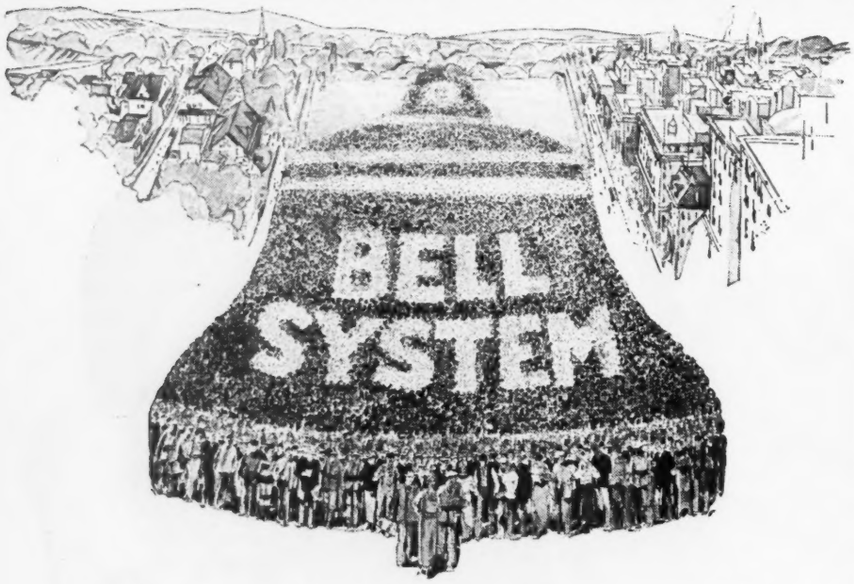

Giving the Telephone Life

Wherever your thought goes your voice may go. You can talk across the continent as if face to face. Your telephone is the latch to open for you any door in the land.

There is the web of wires. The many switchboards. The maze of apparatus. The millions of telephones. All are parts of a country-wide mechanism for far-speaking. The equipment has cost over 2 billion dollars, but more than equipment is needed.

There must be the guardians of the wires to keep them vital with speech-carrying electrical currents. There must be those who watch the myriads of tiny switchboard lights and answer your commands. There must be technicians of every sort to construct, repair and operate.

A quarter of a million men and women are united to give nation-wide telephone service. With their brains and hands they make the Bell System live.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service and all directed toward Better Service

(Patented 1-17-22)

The Midget "Five-in-One" Slide Rule

is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Leather Case 50c extra. Catalogue Free.

Gilson Slide Rule Co., Niles, Mich.

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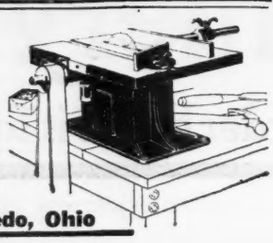


W. & J. Boice, Dept. P.S.-1, 1730 Norwood Ave., Toledo, Ohio

Getting the Most Out of Your Lathe Tools

By Joe V. Romig

Machine Tool Builder and Designer

EVERY machinist will be interested in this article on the controversial subject of the solid forged lathe tool versus the toolbit. Whether you agree with Mr. Romig or not, write briefly the conclusions you have reached on this subject from your own shop experience and address your letter to the Editor of the Better Shop Methods Department, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York. If your letter is of sufficient general interest to warrant its publication, you will receive our usual rate of payment for it.—THE EDITOR.

HOW often have you seen machine operators using toolbits and holders simply because they are less expensive than solid forged tools? This is a penny saving and dollar losing proposition in many cases, particularly if the tools are for roughing work.

The duty of a roughing tool is to make the first cut on a rough casting or forging, and, as the surface is usually covered with scale and dirt, the cutting edge quickly becomes dull. Consequently a large amount of heat is generated and this must be carried away from the cutting edges of the tool or they become too hot and lose not only their temper and hardness but their cutting edge. A tool of large cross section will carry away and dissipate much of the heat and therefore stands up better than toolbits held in tool holders or built-up tools made of welding bits to soft steel shanks.

Rough turning

Although the solid tool is the logical tool for roughing operations, some mechanics seem to learn better by experience than logic, and on one occasion the writer saw the solid tool triumph over the toolbit in a rather spectacular way.

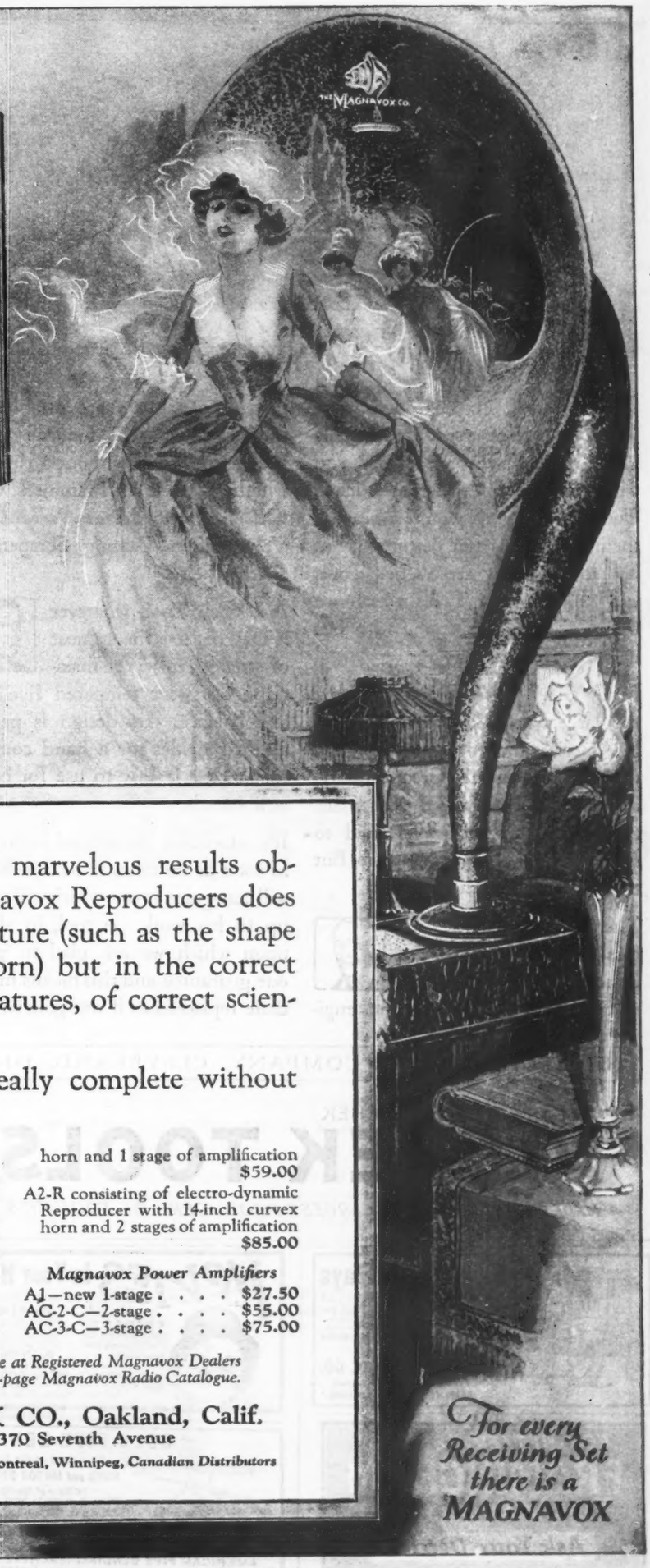
A big battery of motor-driven lathes turning shrapnel cases had been tooled up with tool holders and round toolbits held at an angle, as illustrated on the next page. The metal to be taken off in roughing was tough and full of scale. The fact was that the cases had been heat treated after forging to increase their strength and bring the elastic limit of the steel up to the required specifications.

After laboring along for several weeks with poor results, the plant suddenly began to show increased production on several of the lathes. Upon investigation it was found that the operators had discarded their toolbits and substituted solid tools, which they had borrowed from empty machines assigned to a different operation. The big, husky roughing tools carried away the heat and stood the gaff of the heavy cuts. After that, all the lathes were equipped with solid tools and production jumped to the maximum.

(*Continued on page 94*)

In an easy chair at home MAGNAVOX *gives you the melody of concert and opera*

MAGNAVOX
Radio
Reproducers and Amplifiers



THE secret of the marvelous results obtained with Magnavox Reproducers does not lie in any *one* feature (such as the shape or material of the horn) but in the correct working out, in *all* features, of correct scientific principles.

No receiving set is really complete without Magnavox.

Magnavox Reproducers

R2 with 18-inch curvex horn $60.00
R3 with 14-inch curvex horn $35.00
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A1—new 1-stage $27.50
AC-2-C—2-stage $55.00
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Magnavox Products are for sale at Registered Magnavox Dealers everywhere. Write for new 32-page Magnavox Radio Catalogue.

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For every Receiving Set there is a MAGNAVOX

DO YOU USE TOOLS?

Then Read This!

Look in the tool box, or under the seat of practically any motor car and you will probably find there—Vlchek Tools. Our name won't appear on them, for this is not permitted, but nevertheless they are Vlchek Tools and the kind of Tools which we would be proud to stamp with our name.

In 15 short years we have become the largest tool kit manufacturers in America and that means, in the world. The reason? Great capacity, certainly, and advanced equipment through which we are enabled to secure the lowest possible cost. But there's still another reason.

The advanced Vlchek Process is so accurate, so dependable, so thoroughly efficient in a mechanical and engineering sense, we are enabled to produce Tools that, for every practical purpose, are without a superior whether Ball Pein Hammers, Cold Chisels, Screwdrivers, Wrenches, Valve Lifters, Bearing Scrapers, or anything else.

A Vlchek Tool, whatever it may be, has the utmost of strength in it; the maximum of sweet tempered liveliness and balance. Its design is perfect and it provides for a hand comfort that makes it easy to use for hours at a stretch.

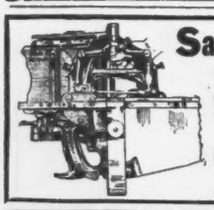
It's a tool that the shrewd mechanic, as soon as he takes it in his hand, will recognize as one which will stand up to his work. A tool, in short, upon which we are glad to place our guarantee and this means immediate replacement if one goes wrong.

THE VLCHEK TOOL COMPANY, CLEVELAND, OHIO

EASY TO SAY VELCHEK

VLCHEK TOOLS

MADE BY THE WORLD'S LARGEST PRODUCERS OF TOOL KITS



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Standard of the World.
HAND and MOTOR OPERATED
14 Sizes of Machines
What it costs to bend pipe our way. Per bend.
1" pipe 5 cents 4" pipe 25 cents
2" pipe 10 cents 6" pipe 60 cents
8" pipe $1.00
Send for Catalogue.

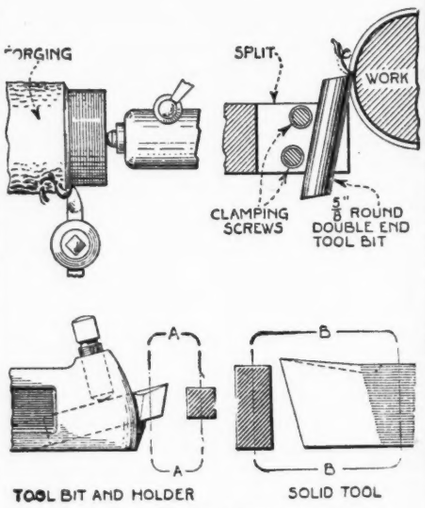
AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. Boston, Mass.

Your Lathe Tools

(*Continued from page 92*)

Part of the work was later subcontracted to an out-of-town firm and the rest of the forgings were sent to them from our own forging plant. This firm also had its troubles, and, not being able to get any production on the rough turning, complained that the metal was too hard and tough to turn and burned up the tools.

After a random selection of shell cases had been returned to us with the statement that they were too hard to turn, the president of the company himself paid us a visit. He found we were running on a surface speed of around 30 ft. a minute, while in his own shop a speed of 60 ft. a minute was demanded of the operators. We used a heavy feed of .09 in., while the



The solid tool for rough turning and types of toolbits and holders for finishing cuts

feed in his shop was only 1/64 in. We were using our heavy tools of 1 by 1¼ in. cross section; his men, ⅜-in. square toolbits in regulation type tool holders (see *A* and *B* above). We turned our cases to size with one rough and one finishing cut, while they had great difficulty in even starting a roughing cut, let alone finishing it. After he returned to his own factory and put in solid tools with a slower speed and correspondingly heavier feed, the work was handled successfully.

In all big steel mills one will see the solid tools used in roughing operations in preference to the toolbit and holder and, in my opinion, it should be the policy of every shop doing rough turning and planing to supply these tools, even if they cost quite a bit more.

The small bit and its holder have a valuable place of their own in the finishing of all kinds of work. Tools of many shapes are required in finishing, and the small toolbit, being ground easily, meets the bill exactly, especially when used in a universal tool holder. For quick, efficient and low cost tool service, the toolbit is ideal for finishing after the big, solid tool has done the rough work.

On fine tool work, where accuracy and finish are absolutely essential, the solid tool must be used. For these tools, a high grade of carbon steel is preferred to all

(*Continued on page 95*)

Your Lathe Tools

(*Continued from page 94*)

high speed and self-hardening grades. This is because the carbon steel takes a finer edge than it is possible to get with the more open structure of the high speed steel.

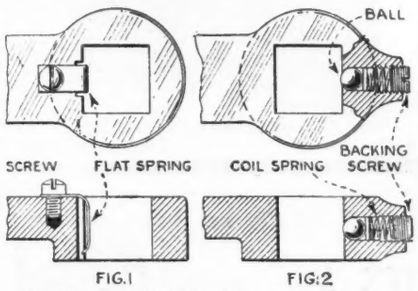
Form tools made of carbon steel will hold their shape and edge through the process of hardening, if not overheated. Practically all high speed steels will scale from the high heat of the furnace and always should be ground to shape to remove the scale.

Common sense practice for a machine operator is to gather a collection of good roughing tools of the solid type and fall back on the toolbits for finishing work.

Fastening Crank Handles

MACHINISTS and toolmakers frequently are annoyed by the ease with which crank handles slip off the square end of the feed screws on milling machines and other machine tools, and drop to the floor. Two simple methods of preventing this are illustrated.

Figure 1 shows how a groove is chipped out of the square hole in the crank handle,

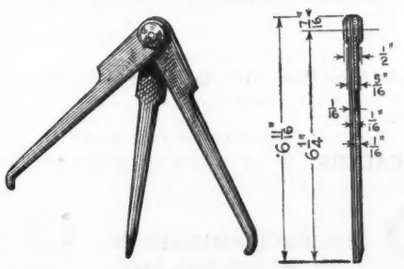


A flat spring (at left) and a coil spring and ball (at right) applied to machine crank handles

and a flat spring is inserted to hold the handle in place.

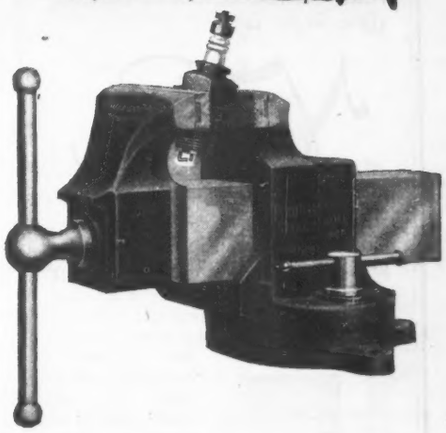
Figure 2 shows what is perhaps a better method. A ball is pressed against the square shaft by a spring, the tension of which is controlled by a backing screw.—C. M. WILCOX, Torrington, Conn.

Combination Caliper for Inside and Outside Measurements



THIS combination outside, inside, and hermaphrodite caliper has proved popular in the shop. When used as an inside caliper, the hermaphrodite leg is turned back and in some instances forms a convenient handle, especially when reaching into very deep, small holes or getting into awkward places. The dimensions shown on the illustration can, of course, be varied to suit individual needs. —WALTER WELLS, Zanesville, Ohio.

"The Third Hand with the Mighty Grip"



This handy vise, with swivel base, can be adjusted at any angle for any kind of work—"Bull Dog" Jaws—for 'all-around' use.

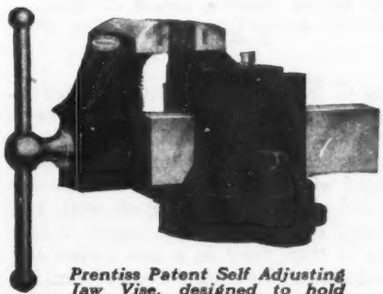
PRENTISS VISE

HOW about those little jobs you were going to do on your car? Have you been delaying because you need a vise—the most necessary tool on any work bench?

The two Prentiss Vises shown here are especially designed for the motor car owner who has his own workbench.

The cost of a Prentiss Vise is very slight compared with the saving you will effect on small jobs—and it will last you a lifetime.

See a Prentiss Vise—"The third hand with the mighty grip"—at your hardware dealer's today. If he doesn't have them in stock fill in and mail the coupon below.



Prentiss Patent Self Adjusting Jaw Vise, designed to hold pieces of any shape with slight pressure. The finest type of vise made. Steel jaw faces interchangeable

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The Master Tool for Production-Building

You can develop machines that do their work automatically. But none do their *best* automatically.

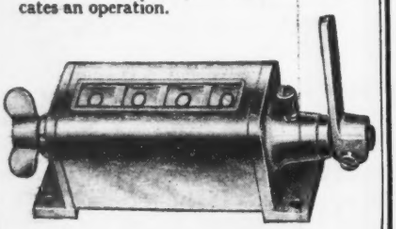
That "best" may be reached by recording the best you begin with—progressing then to *higher* records by improved mechanics and operating methods.

Your out-of-ordinary production is built up and kept up by *records.* And your master tool for building them *high*—is a

Veeder COUNTER

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines and most adaptable to experimental work. If run backward the counter subtracts. Price $2.00. (*Cut 4-5 size.*) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also $2.00.

The Revolution Set-Back Counter below records the output of the larger machines where a shaft-revolution indicates an operation.



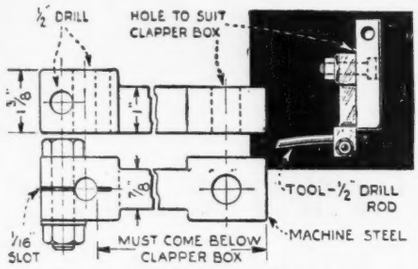
Sets back to zero from any figure by turning knob once around. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list).

Everything you could ask in a counting device is shown in the 80-page Veeder booklet. It's more than worth writing for.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

Special Tool Holder Aids Taper Work on Dies

IN MACHINING blanking dies many odd shapes are encountered and these call for specially shaped tools. To forge these tools from square or flat stock costs too much, and the ordinary tool held in the shaper head is not adjustable. These difficulties can be overcome, however, by the use of the special holder



Working drawing of the tool holder and how it is used with drill-rod tools

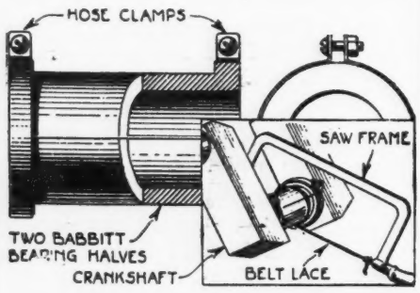
shown. It is designed for tools forged from ½-in. drill rod and allows them to be turned to form the various shapes required.

Drill rod tools are handy for this work, not only because they are a grade of steel of known reliability, but also because they take up a good deal less room than an equal number of rectangular tools.

Crankshaft Bearings Are Trued with Simple Lapping Fixture

WHILE it is generally known that the connecting rod bearings on the crankshaft and the main crankshaft bearings wear oval after a period of use and this eccentricity does not provide a perfect seat for the babbitted bearings, repairmen rarely attempt to true up these parts.

A method one repairman uses with satisfactory results is shown in the accompanying illustration. A lapping fixture is



The lapping members, formed of Babbitt bearings, are revolved with belt lace and hacksaw frame

made of two cast Babbitt bearings removed from the rod and cap of a connecting rod or from the bearing and cap of the cylinder block, and the inner surfaces are charged with emery. These sections are clamped about the crankshaft with two ordinary hose clamps. A length of belt lacing is then fixed in a saw frame and looped around the improvised external lap and used to rotate it, as shown. The method is simple and the time required for lapping is comparatively short.

The Improved **MIRACO** **GETS 'EM FROM COAST TO COAST**

Clearly and distinctly, too! For our users tell us that Cincinnati hears Frisco, Denver hears Schenectady, New York hears Havana! Scores of long distance records were made on these instruments last year so with the many new refinements incorporated the result obtained now will be far better than ever.

HIGHEST QUALITY AT LOWEST PRICE

This has always been the **MIRACO** key-note and the thousands of sets now in use are a fitting tribute to **MIRACO'S** excellent performance. Many new improvements, such as new sockets resting on shock absorbing pad—a refinement found only in the most expensive sets—rheostats with multiple resistance windings, making it possible to use either dry cell or storage battery tubes, and a new aluminum shield that prevents annoying body capacity effects, are embodied.

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2 tube outfit, shown above.....$29.50
4 tube outfit, shown below..... 54.50

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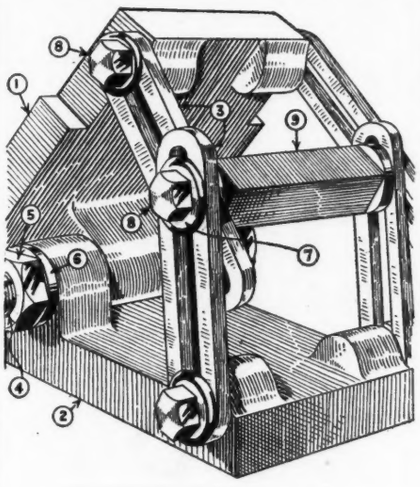
Morrison

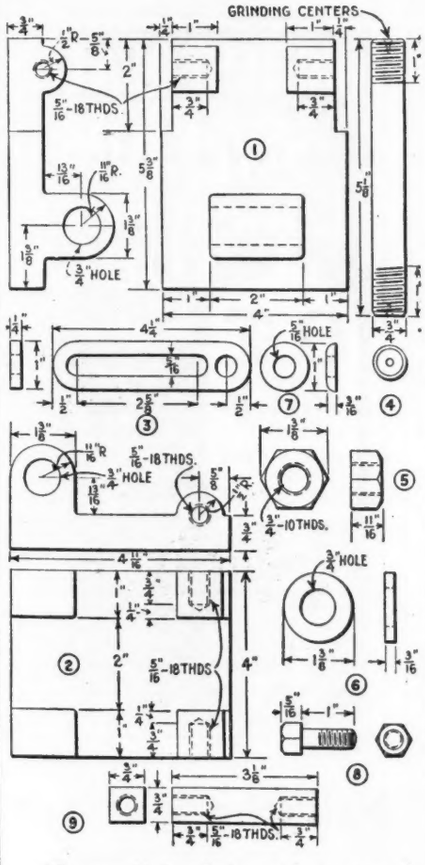
Loud Speaker

Hinged Angle Iron for Machining Angular Work

By Henry S. Laraby

WHEN work is to be held on a machine tool at some angle other than 90 degrees, an adjustable angle iron is a decided time-saver. Few mechanics, however, own or use a hinged angle iron.





The assembled angle iron with the parts numbered for identification, and corresponding details of the parts

Those who wish to add such a fixture to their tool equipment will find that the design illustrated is strong, simple, and adapted to all ordinary uses.

The iron consists of two hinged plates, four clamping arms, and the necessary bolts, washers, and nuts. Both the ad-

(*Continued on page 98*)

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THAT new set that you are planning will be easier to make if you let "Yankee" Ratchet Screw-drivers help you do the job. The "Yankee" Ratchet eliminates the tiresome grip-and-let-go. One good grip and the screw is driven home.

No. 10 (illustrated) comes with 2, 3, 4, 5, 6, 8, 10, and 12 inch blades.
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No. 15 (illustrated) with knurled thumb turn, comes with 2, 3, 4, 5, 6, and 8 inch blades.

A knurled thumb-turn on No. 15 lets you start wobbly little screws easily with thumb and forefinger. A great convenience!

Good reception depends on accuracy. That's why it pays to work with these "Yankee" Screw-drivers that drive straight, true and tight.

Dealers everywhere sell "Yankee" Tools. Make your selection of those that you will need in your radio work. Some of the many "Yankee" Tools are—

Ratchet Hand Drills — **Automatic Push Drills**
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Helpful Tool Book Mailed Free

Describes all the ingenious "Yankee" Tools for saving time and labor. Contains numerous illustrations of these remarkable tools. Write for your copy today.

NORTH BROS. MFG. CO., Philadelphia, U.S.A.

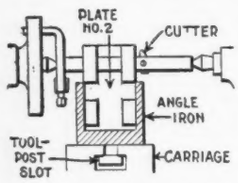
"YANKEE" TOOLS

Make Better Mechanics

Hinged Angle Iron

(*Continued from page 97*)

justable plate and the base are made of machine steel pack hardened to a depth of about ⅛ in. All plain surfaces that must be ground should be .02 in. oversize. The hinge bolt holes should have an allowance of .03 in., while the surfaces of the hinge knuckles where the parts come together should have an allowance of .02 in. The four clamping arms are also made of machine steel.



How the hinge bolt holes are bored

To get the hinge bolt holes parallel to the plate surfaces, it is well to rough bore them first, then clamp the piece to an angle iron that is itself bolted to the lathe carriage, and finally finish the boring with a boring bar held between the lathe centers. A milling machine will do this equally well.

The tool steel hinge bolt should be slightly lapped after grinding to remove the grinding wheel roughness, and the hinge bolt hole should also be lapped until the bolt becomes a wringing fit in its hole. To avoid side play, the hinge knuckles should be lapped to an exact fit.

If screw holes for straps are to be placed in the plates, they should be made before hardening.

Improvising a Reamer

IN OVERHAULING an automobile engine recently for use on a motorboat, I found that the bearings for the crankshaft and connecting arms, which were die cast, required a great deal of scraping. To save time I improvised a reamer from a broken crankshaft of the same size as that of the engine being overhauled. A piece of straight shaft would have done as well.

Along one side of the shaft I chiseled a groove similar to a spline groove and somewhat longer than the new bearing. Then, with a blunt tool like a nut set, I hammered one edge of the groove lightly to raise the edge a trifle. After this had been filed smooth, it made a fair reamer.

The shaft was clamped in a vise, the connecting arm was put on, tightened up and turned around once. It was then taken off and the shavings were cleaned out of the groove. When the reamer had cut to the bottom of the babbitt, the connecting rod was tried on and it fitted very well.

The engine bearings were trued up in the same way by using a reamer made from shafting held in place at one end by an old bearing cap, and turned with a pipe wrench. It is a good plan not to tighten the bearing cap too much, and not to turn the reamer more than once before cleaning the groove, as the chips otherwise tend to roughen the bearing.

The next step was to run the crankshaft in a big lathe for a time. When the caps were taken off, I found we had a good job. —GEORGE H. MURPHY, Wells River, Vt.

I have averaged $7000 Per Year for 3 Years—

Have Made Over $90 Profit in One Day

DePRIES

This is the statement of Frank DePries, one of our live-wire representatives. Keeton of Mississippi made $252 on his first sale. Vickers of Alabama made $118 in one week. Conant quit a $6,000 job to come with us.

AGENTS WANTED

We need more men like these, because the demand for our *Super Fyr-Fyter* is growing by leaps and bounds. Sells to garages, stores, factories, schools, homes, hotels, auto owners. Approved by the Underwriters. If you are willing to work and ambitious to make some real money, get our plan. You need no experience, as we train you without cost for the work. No great capital required. Good territory going fast. Better write us at once.

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We have a plan whereby our active workers can get a Ford without cost, in addition to their big cash earnings. Get the plan—quick!

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HIGHEST QUALITY SILVERTONE Lowest Price TUBES

TONE—like a silver bell
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THREE MODELS

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The New Indestructible— Metalectric Soldering Iron

Operates with the simplicity—efficiency—ease and comfort of a pen, on any current.

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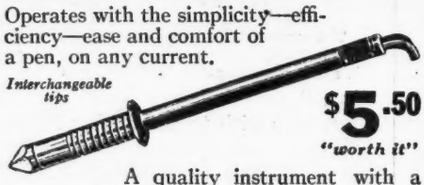

$5.50 *"worth it"*

A quality instrument with a genuine guarantee. Special quarter inch "chisel" tip for fine work furnished at 25 cents extra—*of your dealer or write*

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Setting a Taper Attachment with an Indicator

THE cut and try method in turning a taper can be eliminated by utilizing an indicator to set the taper attachment on the lathe at the proper angle. A test bar or other piece having accurate surfaces is first placed in the lathe. The indicator is then mounted so that it can be moved along the piece at the angle determined by the setting of the taper attachment.

The proper readings for the indicator are next computed and the taper attachment is set to agree with them. Thus, if it

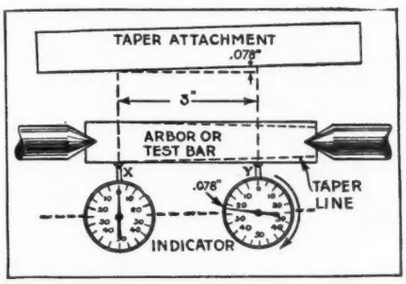


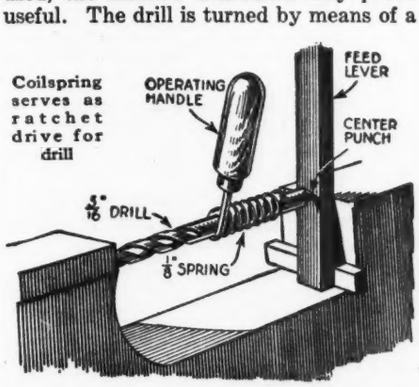
Diagram showing how an indicator and test bar are used for setting a taper attachment for a No. 7 Morse taper

is desired to cut a No. 7 Morse taper, the offset is known to be .625 in. a running foot, or .052 an inch. Since the accuracy of setting is increased by increasing the span, a 3-in. length will give a better setting than 1 in. Therefore the taper should be .078 for 3 in.

The indicator is set against the test bar at a zero reading opposite the first of two points *X* and *Y* that are 3 in. apart. The indicator is then moved to the second point and the taper attachment is fastened so that the reading will be 78 when the indicator is against the surface of the test piece. When a difference of 78 is found in the readings taken between the two points, the taper is correct. The test piece can then be removed and the work turned without trial.

Drilling in Difficult Recesses

TO DRILL holes in narrow recesses where the ordinary ratchet cannot be used, the method illustrated may prove useful. The drill is turned by means of a



spring of ⅛-in. steel wire wound tightly around a rod a trifle smaller than the drill shank and then reamed out to make a wringing fit. Under pressure the spring turns the drill, but it releases its grip on the back stroke.—J. F. D.

NERVE EXHAUSTION

How Nerve Abuse Wrecks Health

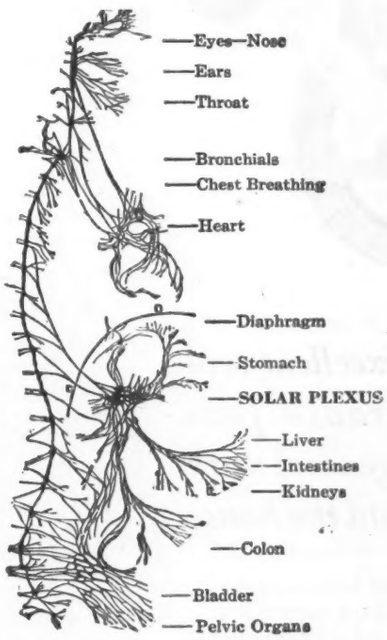
by PAUL von BOECKMANN

LECTURER and Author of numerous books and treatises on Mental and Physical Energy, Respiration, Psychology and Nerve Culture

There is but one malady more terrible than Nerve Exhaustion, and that is its kin, Insanity. Only those who have passed through a siege of Nerve Exhaustion can understand the true meaning of this statement. It is HELL; no other word can express it. At first, the victim is afraid he will die, and as it grips him deeper he is afraid he will not die so great is his mental torture. He becomes panic-stricken and irresolute. A sickening sensation of weakness and helplessness overcomes him. He becomes obsessed with the thought of self-destruction.

Nerve Exhaustion is brought about through nerve strain. There is no other cause. Men strain their nerves through mental concentration and business worries; often, too, through excesses and vices. Women strain their nerves mainly through their emotions, especially those involved in their domestic affairs. Indeed, we are in the midst of nerve strain everywhere due to the mile a minute life we are leading. And no man or woman is so strong as to be immune to this strain.

Nerve Exhaustion is not a malady that comes suddenly, yet its symptoms are unmistakable. It does not manifest itself, as many think, in twitching and trembling hands. The majority of sufferers from nerves seem strong and healthy, and may have not a tremor in their body, yet *inwardly* their nerves are in a turmoil and are undermining the entire bodily organism.



The Sympathetic Nervous System

Showing how Every Vital Organ is governed by the Nervous System, and how the Solar Plexus, commonly known as the Abdominal brain, is the Great Central Station for the distribution of Nerve Force.

The symptoms of Nerve Exhaustion vary according to individual characteristics, but the development is usually as follows: First Stage: Lack of energy and endurance; that "tired feeling." Second Stage: Nervousness; restlessness; sleeplessness; irritability; decline in sex force; loss of hair; nervous indigestion; sour stomach; gas in bowels; constipation; irregular heart; poor memory; lack of mental endurance; dizziness; headache; backache; neuritis, rheumatism, and other pains. Third Stage: Serious mental disturbances; fear, undue worry; melancholia; dangerous organic disturbances; suicidal tendencies; and in extreme cases, insanity.

If only a few of the symptoms mentioned apply to you, especially those indicating mental turmoil, you may be sure that your nerves are at fault—that you have exhausted your Nerve Force.

Perhaps you have chased from doctor to doctor seeking relief for a mysterious "something the matter with you." Each doctor tells you that there is nothing the matter with you; that every organ is perfect. But you know there is something the matter. You feel it, and you act it. You are tired, dizzy, cannot sleep, cannot digest your food, and you have pains here and there. You are told you are "run down," and need a rest. Your doctor may prescribe a drug—a nerve stimulant or sedative. Leave nerve tonics alone. It is like making a tired horse run by towing him behind an automobile.

And don't be deceived into believing that some magic system of physical exercise can restore the nerves. It may develop your muscles but it does so at the expense of the nerves, as thousands of athletes have learned through bitter experience.

The cure of weak and deranged nerves must have for its basis an understanding of how the nerves are affected by various abuses and strains. It demands an understanding of certain simple laws in mental and physical hygiene, mental control, relaxation, and how to develop immunity to the many strains of everyday life. Through the application of this knowledge the most advanced case of Nerve Exhaustion can be corrected.

I have made a life study of the mental and physical characteristics of nervous people, having treated more cases of "Nerves" during the past 25 years than any other man in the world (over 100,000 cases).

The results of this vast experience is embodied in a 64 page book, entitled "Nerve Force," a book that is essentially intended to teach how to care for the nerves and how to apply simple methods for their restoration. It includes important information on the application of deep breathing as a remedial agent. The cost of the book is only 25 cents, coin or stamps. Address me—Paul von Boeckmann, Studio 162, 110 West 40 St., New York City.

This book will enable you to diagnose your troubles understandingly. The facts presented will prove a revelation to you, and the advice will be of incalculable value, whether you have had trouble with your nerves or not. Your nerves are the most precious possession you have. Through them you experience all that makes life worth living, for to be dull-nerved means to be dull-brained, insensible to the higher phases of life—love, moral courage, ambition, and temperament. The finer your brain is the finer and more delicate is your nervous system, and the more imperative it is that you care for your nerves.

"Nerve Force" is not an advertisement of any treatment I have to offer. This is proved by the fact that large corporations have bought and are buying this book from me by the hundreds and thousands for circulation among their employees—Efficiency. Physicians recommend the book to their patients—Health. Ministers recommend it from the pulpit—Nerve Control, Happiness. Never before has so great a mass of valuable information been presented in so few words. It will enable you to understand your Nerves, your Mind, your Emotions, and your Body. Over a million copies have been sold during the past fifteen years.

Millers Falls
Radio
Hand
Drill
No. 85
Price
$2.30

An excellent tool for radio fans and general work around the house

HALF the fun of being a radio fan is in making your own set. And there's a lot of fun in fixing things yourself around the house.

Here's a new Millers Falls tool that's made just right to give you the greatest satisfaction in such work, and you can buy it at a price that will add to its satisfaction. It's called the radio hand drill—No. 85. Takes round shank drills up to ¼", big enough to handle all radio jobs.

See it at your hardware dealer's—if he doesn't carry it write us and we'll tell you how you can get one.

MILLERS FALLS COMPANY
Millers Falls, Mass.
Manufacturers of Carpenters' Tools, Hack Saws and Automobile Tools

MILLERS FALLS TOOLS
SINCE 1868

Non-Tipping Bob Built for Safety

By Henry S. Laraby

OLD as is the sport of coasting, few bob-sleds are built with proper regard to safety. Often the sleds are bolted directly to blocks, so that they cannot rock when going over the snow ruts and bumps, and even when rockers are provided, there is no round block like a fifth wheel to give adequate bearing to the front sled in turning corners. Indeed, the bearing is usually less on the turns than at any other time and since that is just when the maximum support is needed, many an upset happens on curves.

These shortcomings are avoided in the bob-sled design illustrated. Both sleds are mounted on rockers and the upper rocker of the front sled is bolted to a round oak block that bears directly against the under side of the main plank. The bob therefore rides all the bumps easily and takes the curves without danger of upsetting. This flexibility is also a factor in making the bob unusually speedy.

Getting on board for a long coast

The main plank is 1 or ⅞ by 12 in. by 13 ft. The dimensions purposely are kept down in size because the writer's experience in building larger bobs, one nearly 20 ft. long, has been that they are too heavy to pull uphill.

The bob is all oak except the dash and the hood. This makes the construction heavy, but the bob is no one-man pull anyway. Built in this fashion, the sled will stand up under hard usage for years.

The main dimensions and method of construction are made clear in the details. While my preference is for an auto wheel for steering, the bob may be steered with ropes and pulleys in the usual way. The pulley eyebolts are shown on the cross bar. For rope steering a bolt is substituted for the wheel shaft. Note that the lower end of the wheel shaft in this design is split and bent to serve as the upper rockers of the front sled.

The runners are 1 or ⅞ in. (according to the thickness of the sled sides) half oval steel, screwed on. They are better, to my mind, than spring runners, which are bound to come off in time, or flat ones, which sometimes side slip in turning.

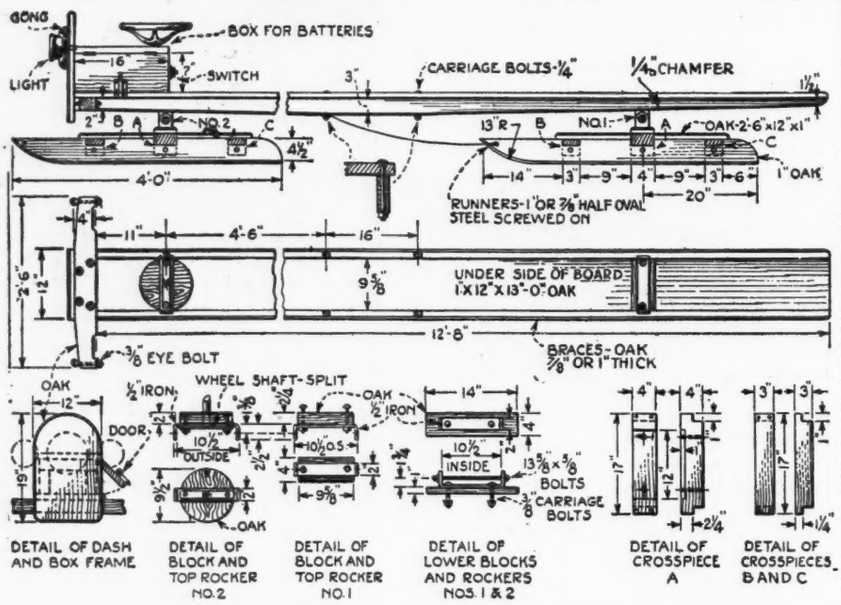
The cross bar is unusually heavy. This is so that it will act as a bumper in a collision and very likely save the legs of the rider from getting hurt.

The hood holds the batteries for the two auto lights and also has room for lunches for the coasting party.

I might add a word of caution in regard to operating the bob. Either pick a steersman who knows his job or stick to low hills until experience is gained in handling the sled.

If a rope is used, be sure it will stand the gaff. I well recall once trying out a bob built along identical lines, only larger. About 18 of us were going down the hill when a rope broke and we hit a post. We went sliding forward over the dash, over a fence, and down over a 20-ft. drop into a creek. Every one hit his head on the top rail of the fence and teeth were lost all around.

On another occasion we iced the hill with a hose and as a result went through the front porch of a house. So coasting, while one of the most thrilling of winter sports, is not to be approached with any display of foolhardiness.

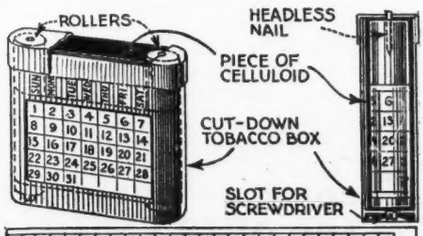


Side view of the bob, the under side of the main plank, and details of the dash, blocks, and rockers, and cross pieces. The sled can be steered either with an auto wheel, as shown, or in the usual way with ropes

Tin Tobacco Box Used for Novel Perpetual Calendar

A PERPETUAL calendar, good not only for 1924, but for any year, can be made at practically no cost.

After cutting down an empty tobacco box of the oval pocket kind to 2¼ in. high, make a 1¼ by 2 in. opening in one side. Next make two wooden rollers, as



How the calendar is made and assembled

shown, with headless nails driven in the ends to engage holes punched in the top and bottom of the box.

Prepare a strip of paper a little narrower than the height of the box and long enough to pass around the two rollers, allowing a lap for pasting. Divide and number as indicated, assemble the whole, and gild or paint the case.

Place the figure 1 under the day of the week on which the month begins.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
225 West 39th St., New York.

GENTLEMEN:

Send me the blueprint, or blueprints, I have checked below, for which I inclose.....cents in stamps or coin:

No.	*Title*	*Price*	
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10.	Porch Swing	25c	☐
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14.	Toy Train, Horse, and House	25c	☐
15.	Home Workshop Bench	25c	☐
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17.	Cedar and Mahogany Chest	25c	☐
18.	Telephone Table and Stool	25c	☐
19.	Grandfather's Clock	25c	☐
20.	Flat Top Desk	25c	☐
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25.	Sailing Outfit for Canoe	25c	☐
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27.	Kitchen Cabinet Work Table	25c	☐
28.	Pullman Play Table	25c	☐
29.	Toy Tea Cart, Garage, etc.	25c	☐
30.	Tool Cabinet, Bench Hook, etc.	25c	☐

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(Please print)
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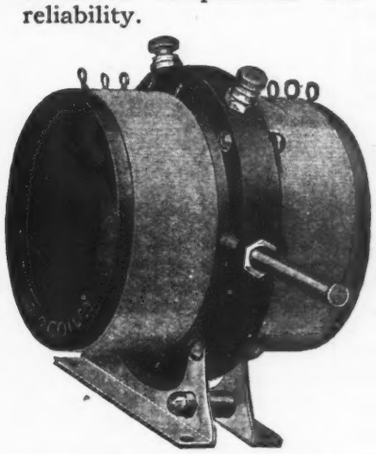
"Built First to Last"

Make it a Coto Compact Radio Christmas

YOU have plenty of time to build a Coto Compact set before the holiday. Get together with your local dealer. He will advise you and help you get real results. And give presents of Coto Radio Apparatus this Christmas. Always most acceptable to radio enthusiasts of all ages. In a class alone for combined compactness and reliability.



Coto Compact Moulded Variocoupler

Compact for neat, portable sets. Size only 3¼ x 3 x 3¾ inches. Efficiently covers range of 200 to 600 meters. Eight taps for use with primary condenser. Pigtail connections to rotor. Base or panel mount. Type 9000. - - $5.50

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New Coto Compact Moulded Variometer

Size only 3¼ x 1¾ x 3¾. In moulded bakelite. Stator is honeycomb wound. Pigtail connections to rotor. Range 200 to 600 meters. Base or panel mount. Type 8000..... $5

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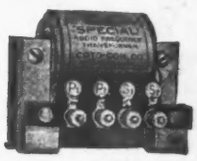
Only 2 7/8 inches square. Rotor plates soldered to shaft. Stator plates soldered to supports .0005 Mfd. $5 .001 Mfd. $6



Coto Special Audio Frequency Transformer

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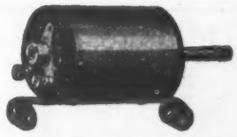
Popular low priced favorites of the amateur and experimenter. Permit the economical building of an all wave set. Sold mounted or unmounted.



Coto Tapped Radio Frequency Transformer

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The story of radio rescue when the Honolulu sank is but one of hundreds in the lives of far-traveling radio operators. It has always been a life of fascination—and today offers a big future.

Over 6,000 operators have already graduated from our school. And many more trained men are needed. Study at home in your spare time.

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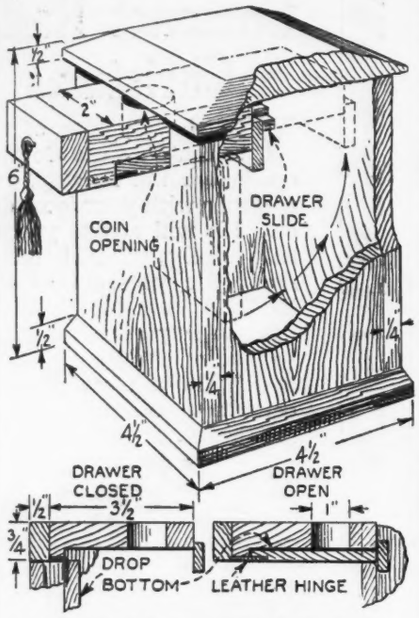
Child's Wooden Savings Bank Has Trick Drawer

By Kenneth R. LaVoy

CHILDREN take delight in depositing money in this unique wooden bank because of the ingenious construction of the drawer, which allows coins to be put in but not removed. The bank, if carefully made and well finished, is an ornament on a shelf or bureau. A silk tassel



A coin placed in the opening in the drawer falls to the bottom of the box when the drawer is pushed in

hung from a small cup hook makes a decorative drawer pull.

Nails are used throughout to hold the parts together with the exception of the bottom piece, which is fastened with screws. This permits the removal of the coins, when the bank is full, without destroying it. The nails should be set in and the holes plugged with putty. Two coats of enamel give a satisfactory finish.

On the February Schedule

FOR the woodworker there will be details of an especially attractive Priscilla sewing cabinet as well as a straight-legged cabinet of modern design. Other articles will tell how to make inlaid serving trays from cigar-box wood, a neat cabinet for stains and chemicals, and a plant stand with ornamental trellis.

Roland B. Cutler, specialist in the construction of toys that boys like to build, will tell how to make a ski-sled. Dr. E. Bade will give unusual designs for decorative weather vanes.

R. J. Stephens, who wrote the remarkable home-building story that appeared in the January, 1923, Popular Science Monthly, writes on "How to Save Money in Building a Small Home." Joe V. Romig takes for his topic, "Getting the Most Out of Your Tools."

Auto kinks, suggestions for metal workers, radio stories, the Shipshape Home and Home Workshop Chemistry columns, and a wealth of other material will complete the department.

Think of the repair work on thirteen million cars! Engines, electrical systems, batteries, tires, etc. There are not nearly enough **trained men** to do this work. Graduates of this School (all over the world) are successful, making money in this business, either in good jobs or shops of their own. Age, education, or experience make no difference. You can be successful too, if you will get M. S. A. S. practical training **now.**

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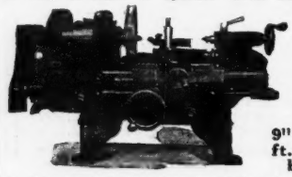

$245

9" lathe—2½ ft. bed—with bench legs

SEND for Free catalog of MONARCH lathes which are built up to 30" swing

THE MONARCH MACHINE TOOL CO.
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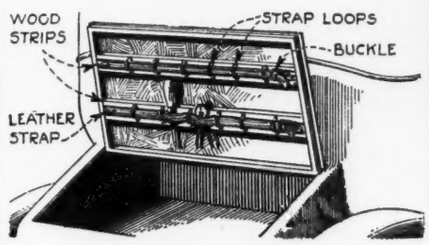
Built-In Tool Rack Is Useful Addition to Roadster

THE cover of the rear compartment on a roadster is an excellent place for installing a tool rack. Two or three pieces of wood are screwed to the frame under the lid and are fitted with metal strap loops. A leather strap is fastened at one



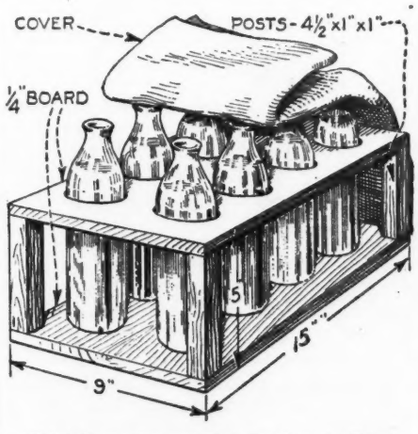
When tightened and buckled, the straps hold each tool firmly in its own place in the cover of the rear compartment

end of each wooden strip and a buckle for tightening it is placed at the other end.

Small tools that are not readily held can be fixed by cutting a recess into the wood with a gouge or chisel. All rattling and damaging of tools is thus avoided, and tools are always conveniently at hand when needed.

Holder for Baby's Bottles

CARING for baby's bottles is an exacting task that is lightened by the use of the simple stand illustrated. The top and bottom are of ¼-in. wood nailed or



This labor-saving container for glass sterilizers is made of two thin pieces of wood and four small posts

screwed to four supports. Eight holes are drilled in the top piece ⅛ in. larger in diameter than the bottles. The filled bottles are set in the holder, covered with a cloth and placed in an icebox compartment.—FRANK N. COAKLEY, Buffalo, N.Y.

TO CUT a stovepipe, mark off the length to be cut and scribe a line around the entire pipe. File a small hole with a three-cornered file on the line just scribed and insert the blade of a can opener in the hole. Then cut the pipe like an ordinary tin can. This will leave edges that are cleaner cut than if tin snips were used.—EDWARD W. PRASEK, Cleveland, O.

An Appreciated Gift

Charges Radio and Auto Batteries at Home Over Night - For a Nickel!

For a friend who owns a radio set or automobile, what could be more appropriate than a gift which would eliminate the inconvenience and expense of taking his battery to a service station every time it requires recharging? The

GOLD SEAL HOMCHARGER
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is such a gift, appropriately dressed up in a beautiful Christmas package, too. It charges any AUTO, RADIO or "B" storage battery in the simplest, quickest and most efficient manner possible. Connects to any lamp socket—operates silently—requires no watching. Fully automatic in operation—absolutely safe.

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with 33 branches, located in all principal cities of the United States, teaches the highest degree of Barber Service—in a few weeks—places graduates in positions paying up to $75 a week or enables men to make up to a thousand dollars a month in his own shop.

Next to the Surgeon, there is no one in whom the public place themselves with so complete confidence as they do with the modern Barber—they want Moler Service and will pay for it.

Scientific Barbering means Moler Methods. Our short practical course—saves 2 years of apprenticeship—teaches you Bobbing and Marcelling—gives you short cuts to big pay, puts you in line for one of the Moler Shops—service of which is being advertised nationally. Moler methods—Moler Service mean success for you from the start and you can learn them right near home.

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Booklet C, which is mailed Free—will tell you how the training puts you into the best shops, or if you will, helps you get started in your own business by equipping your shop on easy terms. In fact Moler takes you as you are—makes your life work easier, better paying—and more gratifying.

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"My shop has doubled its receipts since becoming one of the Moler Chain Shops. The business-like way in which your advertising educates my customers to this service has worked wonders. The protection you give me in this exclusive territory insures my future.

"I am proud to say I am a Moler Post Graduate Shop Owner."

Another Post Graduate says—

"My position in the Moler Post Graduate Chain Shop is entirely satisfactory. I had never supposed a Barber Shop could be conducted on so high a standard in service and morale. Women and children, also, do not hesitate to patronize us for their Bobbing and Marcels.

"This Post Graduate Service is surely a revelation in Barbering."

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Name .....

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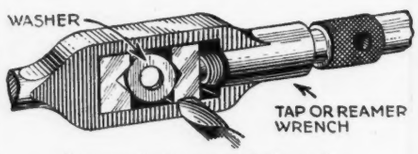
Tap Wrench Holds Small Washers for Reaming

WHEN it is necessary to enlarge a hole in a small washer, the job is easily done, if a lathe is at hand, by chucking the washer and running a boring tool through. Lacking a lathe, however, the job is of the "mean" variety, because



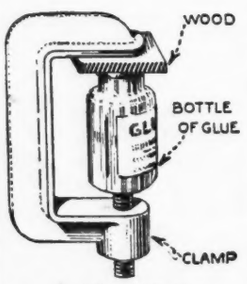
A convenient way to hold washers firmly without damaging them

it is difficult to hold the washer while drilling or reaming it.

A simple expedient is to grip the washer in a tap wrench, as shown. This does not disfigure the face of the washer, which often is important, and any slight marks on the edges can readily be removed as a rule. If appearances are especially important, the edges can be protected by strips of softer metal, fiber, or cardboard.—H. G.

To Keep Glue Can or Bottle Tightly Closed with Clamp

TO KEEP the liquid glue can or bottle properly sealed is always a problem. If the cap or cork is closed tightly, it sticks and is difficult to remove; if it is put on loosely, the glue gets hard.



A tight stopper, easily removed

Recently the writer hit upon the method illustrated and finds that it works very well. Simply use a flat piece of wood and a cheap clamp. Place the wood over the opening of the can or bottle and clamp it on. It makes an absolutely tight joint, is easily removed, and if too much glue adheres to the wood, it is a simple matter to find a new piece that will do.

The container may be put away in a drawer or box on its side, or it may even be hung by the clamp on a nail. Even if it is upside down, there is no danger of leakage.—N. G. NEAR.

Cracks in Castings

TO PREVENT a crack in a casting from extending, the usual practice is to drill a hole at each end, but this frequently fails because the holes were not drilled in the proper place. To determine exactly how long a crack is, cover the surface with a mixture of equal parts of kerosene and oil. Allow it to stand for a time, wipe the surface clean, and brush on the whitewashing mixture used when laying off lines. The crack will show up clearly.

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Own a money-making battery charging business. No experience needed. Small cash payment brings you HB 8 hour charging outfit. Easy $20 monthly terms let your profits pay balance with nice surplus besides. Thirty day free trial on money back guarantee. You can easily clear $150 to $300 every month. Write today for Bulletin 321. HOBART BROS. CO. Box P1, Troy, Ohio

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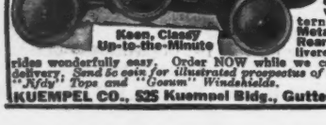
Other types down to $3.50. Famous sure fit, Patented life-size patterns and picture instructions show how. You can easily convert your Ford into this fast, saucy Sport Car as hundreds have done with a few dollars worth of material from the hardware store. No need to lay up the car. The "PAL" with conical disc wheel patterns. Pressed Metal Streamline Rear only $6.40 delivered. Built low, rides wonderfully easy. Order NOW while we can make good delivery. Send 5c coin for illustrated prospectus of Sport Bodies, "Ryde" Tops and "Goum" Windshields.



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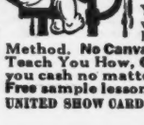

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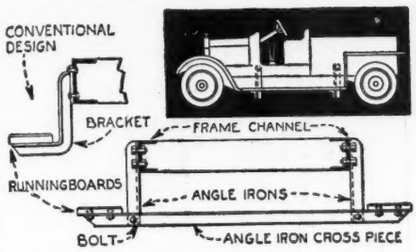
Strong Runningboard Brackets Made of Angle Irons

WHEN rebuilding or repairing trucks and touring cars, it is often a problem to hold and support the runningboards effectively. The conventional goose-neck type of support has drawbacks and weaknesses and, when once wrecked, is hard to straighten. The strongest type of homemade support is constructed of 1½-in. angle iron, which is cheap and easy to obtain.

Two short lengths are bolted with ⅜-in. bolts to opposite sides of the frame channels, as shown. To them at the bottom is bolted a long, straight piece of the same material for carrying one end of the runningboards, which are attached with countersunk ¼-in. carriage bolts. Each cross piece stiffens the whole assembly. Avoid drilling more holes than absolutely necessary in the frame of a machine, as the holes tend to weaken the cross section.



In replacing or strengthening a broken runningboard, this construction insures durability

A good grade of linoleum should be used to cover the wooden boards, and brass or aluminum stripping to bind the edges. When any heavy equipment is carried on the runningboards, such as camping supplies, the regular runningboards should be reinforced in this way with angle iron supports.—J. V. R.

Thimble Makes Neat Ferrule for Small Tool Handle

IN THE home workshop it often becomes necessary to make a tool handle from a piece of broom handle, old chair rung, or dowel. Such a whittled handle, however, splits almost invariably where the tang of the tool is inserted unless it has a reinforcing ferrule.

A homemade handle is saved from splitting by the use of an old thimble

To provide a ferrule quickly, try to find an old thimble. Drill or punch a hole through the end of the thimble and whittle the ferrule end of the handle until it is a drive fit in the thimble. Hammer it on and insert the tang of the tool.

Not only does the thimble solve a difficult problem cheaply and quickly, but it makes a neat finish.—J. H. S.

The New
MU-RAD RECEIVER
MA-15

THE HORIZON of the radio art extended and broadened by this new perfection of radio reception—the more versatile, more simply operated receiver, *Mu-Rad MA-15*. Many important refinements—plug-in type radio frequency transformers, so that the MA-15 can be accommodated to any future changes of wave lengths or tubes, volt-meter for instantaneous readings of "A" or "B" batteries, new type vernier dials, operated by cams to eliminate back-lash, no other aerial than a 2-foot loop needed, and a wave length switch for bringing in short wave stations. Solid mahogany cabinet, with an engraved Formica panel. The MA-15 anticipates every possible use and requirement. *Guaranteed range, 1,000 miles using 2-foot loop.*

Another New MU-RAD Receiver MA-17

Three stages of radio and two of audio frequency amplification and detector. *One* tuning dial and two selecting dials, each independent of the other. Plug-in type r. f. transformers to care for changes of tube type or wave lengths. Panel-mounted volt-meter for quick reading of A and B batteries. Solid mahogany, Adam Brown hand-rubbed finish cabinet with loop fitted into top and compartment in base for "B" batteries. Guaranteed for 1000 miles reception using only a 2-foot loop.

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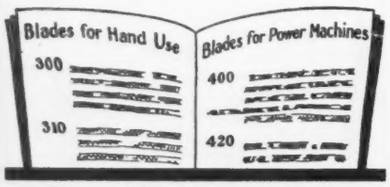

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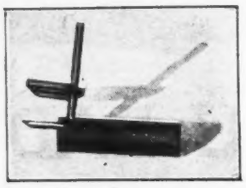
Cheap Balsam Microscope Reveals Hidden Wonders

By William J. Edmonds

MANY wonders of the invisible world are revealed by the quickly and cheaply made balsam microscope illustrated. The handle is a piece of broomstick about 1 in. in diameter and 4 in. long. A length of ⅛-in. wire is inserted near one end so as to project about 3 in., as shown, and a saw slot is cut in the end of the handle to carry the lens unit.

To make this unit requires first a piece of glass, 1¼ by 2 in., as free from flaws and bubbles as possible. The edges must be smoothed and the surfaces carefully cleaned. On one side a piece of black paper is securely fastened with glue. In the center of the paper a pinhole is made.



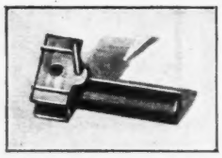
Handle, lens unit, and sliding stage

On the other side of the glass, opposite the pinhole, the lens proper is formed of Canada or other crystal-clear balsam. The balsam is placed on another piece of glass and boiled. While it is liquid, all bubbles are broken by means of a pin point. A drop of this clear liquid balsam is then placed on the lens slide directly opposite the pinhole in the black paper. It should be as nearly circular as possible.

The slide is then laid across an open box to protect it from dust and to prevent any injury to the lens while it is hardening. It is advisable to make several lens units and test them; one is almost certain to be distinctly better than the others, and it should be retained.

The stage is a glass strip 1 by 2 in., backed up by a piece of thin wood with a ⅛-in. hole bored in it to come opposite the center of the glass, the two being held together by means of two rubber bands. The wood has a lower semicircular ear with a ⅛-in. hole to slip over the 3-in. long wire slide. The surface of the wood that comes in contact with the glass strip is painted a dull black. Drawing ink may be used for coloring it.

The units are then assembled, the drop of balsam being on the side of the lens unit facing the stage. The object to be examined is placed on the stage and focusing is accomplished by sliding it back and forth on the wire rod.



Bottom view, showing hole through stage

With this microscope a drop of water will seem like a small world, and even the simplest specimens will be found of fascinating complexity.

TO DO concreting in cold weather, heat must be provided. For temperatures not lower than 22 degrees, 1½ lbs. of salt to 18 gals. of water can be used as a mixing fluid. Otherwise the materials and the mixing water should be heated with fire or steam.

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Unscrew the cap on the ear piece. Place the thin circular diaphragm on the counter. Hold the ear piece above it and see how powerful the magnets are in picking up the diaphragm.

Try the same test with any other head-set and notice the difference. Powerful magnets in a Radio Headset give strong, clear signals.

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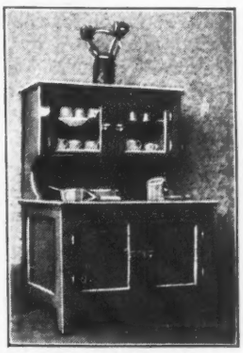
Miniature Kitchen Cabinet Is Novel Toy for Little Girls

By Herbert A. Mincher

A SMALL kitchen cabinet, standing about as high as a table, is a toy that provides perpetual entertainment for small girls. To build one requires only a hammer, saw, square, chisel, plane, screwdriver and miter box. The materials needed are:

1 piece ¾ by 1½ in. by 10 ft. (plowed ¼ by ¼ in.) for bottom section end frames
1 piece ¾ by 1 in. by 12 ft. (plowed ¼ by ¼ in.) for door frames
1 piece ¾ by 1½ in. by 11 ft. for top and bottom front frames
1 piece ¾ by 6 in. by 4 ft. for top section ends
1 piece ½ by 5¾ in. by 5 ft. for shelves
1 piece ½ by 14½ in. by 1 ft. 9 in. for table top
1 piece ½ by 7¼ by 1 ft. 9 in. for top
1 piece ½ by 13 in. by 1 ft. 7 in. for bottom
1 piece ½-in. quarter-round molding for bracing back and bottom
1 piece wallboard, plywood, or plaster board 3 ft. by 3 ft. for back, door panels, and end panels
2 pieces 6¼ by 9½ in. selected sheet glass
4 door catches
8 1-in. narrow butt hinges

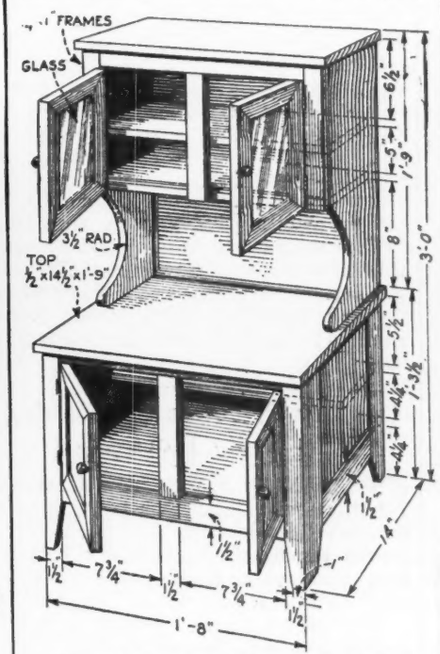


The finished cabinet with toy dishes

The cabinet is made in two sections, the upper part being fastened to the lower with screws put in on an angle under the table top.

The writer first cut the legs and the rails for the ends, which are made of ¾ by 1½ in. material plowed on one edge ¼ by ¼ in. for the plaster board panel. The groove should be made to suit the thickness of the paneling used, which may be wallboard, plywood, or solid stock. These pieces are nailed together and reinforced

(*Continued on page 108*)



The chief dimensions of the cabinet, which is made in two sections fastened together with screws, the other parts being nailed

Thackeray liked his pipe and said so

—a great physical aid in conversation

William Makepeace Thackeray must have felt more than friendly towards smoking, for he wrote:

"Honest men, with pipes or cigars in their mouths, have great physical advantages in conversation. . . . The pipe draws wisdom from the lips of the philosopher and shuts up the mouths of the foolish."

Often you see two men sitting comfortably smoking their pipes in silence. They have no need for talk. The quiet puffing at their pipes is sufficient bond between them. Or you will see other men sit for hours in friendly discussion with pipes going all the time. Here the pipe seems to draw them out.

And yet, for all its sociability, the pipe is a great solace to the man who finds himself all alone. As a real companion you have to travel far and wide to find anything to beat the pipe.

You have any number of brands to choose from. No matter how hard you are to please, you can surely find the tobacco that suits your smoking temperament.

If you haven't tried Edgeworth, there is a fairly good chance that it is the tobacco you have always been hoping to find.

Edgeworth has made thousands of friends in all parts of the country, and each year it makes more and more new friends.

If you will send your name and address, Larus & Brother Company will be glad to send you free samples both of Edgeworth Plug slice and Ready-Rubbed.

A few pipefuls should suggest to you whether or not you care to go further along the Edgeworth trail.

For the free samples, address Larus & Brother Company, 59 South 21st Street, Richmond, Va. If you will also include the name and address of your regular tobacco dealer, your courtesy will be appreciated.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

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Print or write plainly

Miniature Kitchen Cabinet

(*Continued from page 107*)

on the inside with corrugated joint fasteners.

The frame for the front is then made from ¾ by 1½ in. material (not plowed), the ends and front assembled, and the bottom and shelf put in before the top is nailed on. After the top is on, the back panel is fitted and nailed.

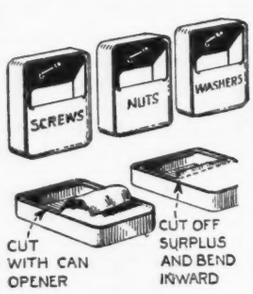
The frame for the front of the top section, made of ¾ by 1½ in. material (not plowed), is cut and assembled and the end pieces cut to the shape shown. The front is then nailed to them. The shelves and top are next put on and the back fitted and nailed.

The doors are then made and fitted. In making the doors for the top section, one edge of the plowed ¾ by 1 in. material is cut out in order to allow the glass to be inserted from the inside. The glass is held in place by small wooden strips.

The cabinet illustrated is made of cypress, stained with dark oak oil stain and varnished. Another neat finish is obtained by giving the cabinet one coat of flat white paint or enamel undercoat and one or two coats of white enamel.

Sardine Cans Make Handy Nail and Screw Holders

THE next time you have sardines, do not open the can in the usual way, but cut halfway around the top and remove all but ¼ in. of the flap, as shown. After the can has been emptied and cleaned, bend back the ¼-in. strip to make a smooth edge, then punch a hole in the can so it can be hung up as a container for small nails, screws, tacks, and the like. I have been using this idea in my home workshop for a number of years and find it a good one.—HAROLD GUSTAFSON, Chicago, Ill.



A workshop use for discarded cans

Old Dry Cell Aids in Cleaning Sooty Flues

CLEANING the soot from furnaces, stoves, and chimneys is a disagreeable job, but it can be made a lighter task by simply tossing a discarded dry battery into the stove or furnace at some time when there is a particularly hot fire.

This will quickly dissipate much of the carbon and soot formation, and, if repeated from time to time, soot will not accumulate to any extent. Scrap zinc in any form has a similar effect and may be used if an old dry cell is not at hand.—GLEN F. STILLWELL, Collinsville, Ill.

LIQUID wood filler and substitutes for varnish should not be used as a first coat on floors, as the durability depends largely upon the first coat.

John Davey *needs young men*

John Davey's organization, The Davey Tree Expert Co., Inc., has a limited number of openings for ambitious young men between 20 and 30 years of age, single men preferred. The opportunity is unusual, offering good pay at the start, permanent employment in the Davey organization, and thorough scientific training in the profession of Tree Surgery. Advancement rapid, according to merit. The work is fascinating, offers chance to travel extensively, and association with fine fellows. Only clean, red-blooded young Americans, lovers of the outdoors, need apply. Write, giving full information to The Davey Tree Expert Co., Inc., 55 City Bank Bldg., Kent, Ohio.

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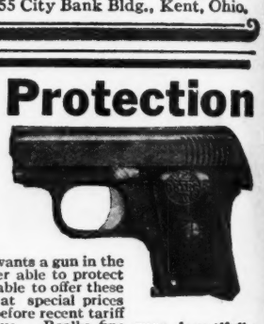

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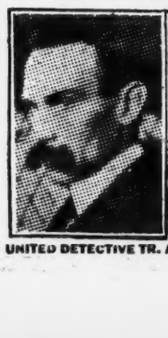

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UNITED DETECTIVE TR. ASS'N., 807 Dinan Bldg., Detroit, Mich.

One-Tube Radio Set

(*Continued from page 79*)

nected with binding post *K*, while binding post No. 2 of the same rheostat is connected with the remaining *F* terminal of the socket.

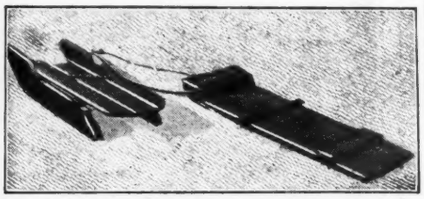
One of the rotor leads is then connected with the *P* terminal of the socket, while the other lead is connected with binding post *J*. No leads are connected with binding post *M*, this post serving as the connection between one phone terminal and the positive terminal of the B battery.

In operation, the aerial is connected with the aerial post *A* and the ground wire with the ground post *B*.

The negative of the A battery is connected with binding post *K*. The positive of the A battery and the negative of the B battery are connected with binding post *L*. The positive of the B battery and one of the phone terminals are connected with binding post *M*, and the other terminal of the phones is connected with binding post *J*.

Quickly Made Wooden Sleds

ALTHOUGH they have flexible steel sleds, my boys, at the first fall of snow, kept trying to slide down a snowbank on boards. I split a short length of round stove wood into quarters, and



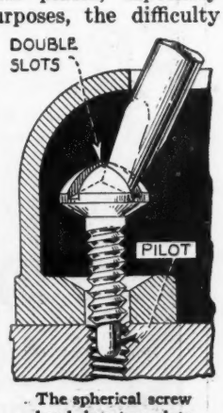
A safe sled for little tots, made of box wood, and a board toboggan

nailed one of these quarters to the front of a wide board. This makes a first-rate toboggan, as shown in the photograph, and the children have lots of fun with it.

Out of box boards in about half an hour I also made a wooden sled that is safe and practical for a three-year-old.—H. T.

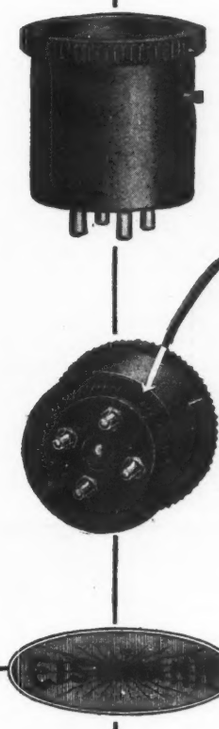
Double-Slotted Adjusting Screw for Awkward Places

WHEN it is necessary to use screws in inaccessible places, especially for adjustment purposes, the difficulty of inserting and turning the screws can be reduced by making them as shown.



The spherical screw head has two slots

This type of screw has a spherical head and two slots at right angles to each other. A pilot on the end of the screw guides it into its hole. This is a method I have used to advantage in assembling telescopes.—O. S. M.



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A combination adapter and resistance coil for UV-199 and C-299 Radiotrons. It fits any standard base socket.

A coil having 18 ohms resistance is embodied in the base.

In changing to UV-199 or C-299 tubes, it is only necessary to connect to a filament battery of proper voltage and insert this combination Resistance-Adapter.

It is unnecessary to substitute a high resistance rheostat or use an extra coil. The required resistance is obtained by using this combination Resistance-Adapter in series with a low resistance rheostat (4 to 10 ohms).

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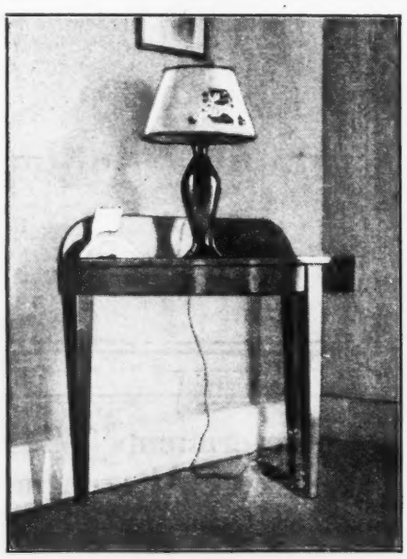
Transforming an Old Pedestal Dining-Table

By Stanley W. Blanchard

STYLES in home furnishings are changing. The living-room is expanding and taking in the dining-room. It is now quite correct for dining- and living-room to be merged into one long room. Houses are being built this way and the partition is being torn out in old houses to achieve the same effect.

The transformation of the two rooms into one calls for some arrangement of the furniture, but this presents no great difficulty, except the problem of what to do with the dining-table if it is of the pedestal base type. Instead of fitting in with its surroundings, it insists on standing out and proclaiming itself to be a dining-table and absolutely nothing else.

The problem was well solved in one case by removing the top from the base,



Half a pedestal dining table reconstructed into a three-legged writing-table

discarding the latter, and fitting each half of the round top with three square, tapered legs, thus making two half-round tables of pleasing lines. These take up little room with their backs to the wall and yet can be moved out and placed together in a minute for duty as a dining-table.

This plan makes an exceptionally convenient arrangement for the small apartment where space is at a premium, but it may be used in any home, as additional space is always welcome.

If you have a dining table that is not being used, or possibly has the base broken, it can profitably be made into a pair of these tables. One of the halves can also be transformed into an attractive writing desk by the simple addition of a back that projects above the top for 6 or 7 in., and a rack for letter paper and envelopes at each end.

The accompanying illustrations give a good idea of possible construction in making the changes, but as all dining tables are not the same, it will be necessary to use your ingenuity.

The same kind of wood should be

(*Continued on page 111*)

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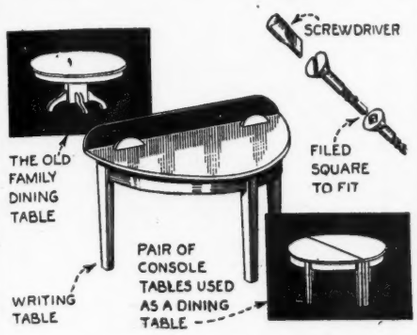
Transforming an Old Table

(*Continued from page 110*)

used, if possible, in making the new back and legs as was in the original top, unless the table is to be painted. The finish on the old table top should be removed entirely with varnish remover and well

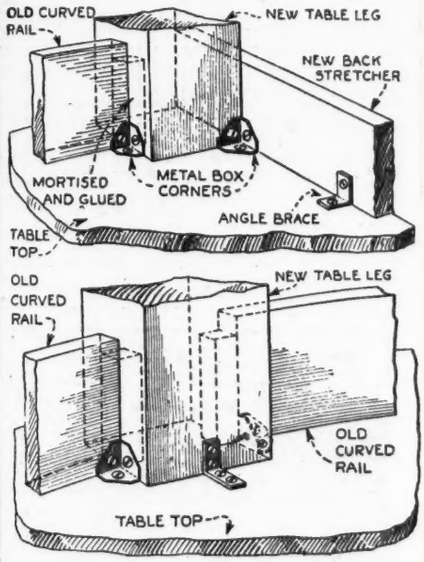


Suggestions in remodeling a pedestal dining table and method of withdrawing the sockethead screws sometimes encountered

sanded; then the whole table can be refinished at the same time.

In taking the old table apart, it may be found that screws with a square socket in the head were used in fastening the parts together instead of the usual slot. A key to remove them can be made by filing the end of an ordinary screw square to fit in the socket.

One half of a small dining-table can be converted with a little ingenuity into



Details of the new rear-leg construction (above) and the method of fastening the center leg (below)

a dressing-table if a back, fitted with mirrors, is added.

The results obtained in rebuilding old pedestal dining-tables are so pleasing that it might pay to purchase a second-hand table, if necessary, as the finished tables are worth from $20 to $25 each.

FUMBLING for the keyhole when unlocking the door in the dark is obviated by gluing a hand of an old luminous watch so that it points to the keyhole.—C. D. T.

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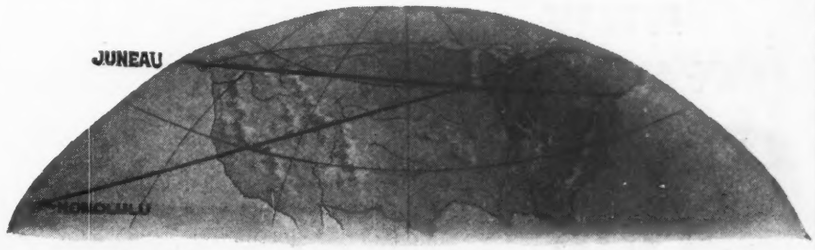
With Erla Synchronizing Transformers



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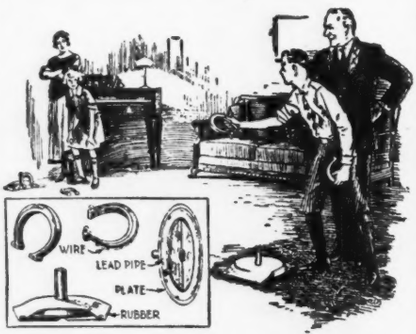
Parlor Ringers Played with Rubber Horseshoes

By Roland B. Cutler

OUTDOOR sports seldom can be brought into the house without losing action, but realistic barnyard golf can be played in the "best room" with the home-made equipment illustrated.

Pitching horseshoes is popular with everybody and the indoor game calls for the same skill of hand and eye as the outdoor. With an old automobile tire and two 10-in. pie plates you may make parlor equipment that is as reliable as it is inexpensive.

Each plate is fitted with a wooden bottom made of ¾-in. matched stock in two halves. A broomstick stake, 3¾ in. long, is inserted in a hole in the wooden base and nailed in place. The stake is



Pitching horseshoes indoors with equipment made from an old auto tire, an inner tube, pie plates, wood, and wire

then passed through a hole cut in the tin plate and the plate is nailed to the wooden bottom. About 22 in. of lead pipe is then wedged around the bottom against the rim of the plate and nailed to the wood.

A rubber jacket provides suitable "ground" and protects the floor. It is an 18-in. length of discarded inner tube. Open it up to inclose the plate and fasten under the bottom with lacing or tacks. Reinforce it with stitches at each corner, as shown.

The four shoes should be about ¾ by 5 in. A knife and hacksaw will cut the tire. Although pitchable "as is," a shoe can be shaped almost rigid with heavy wire such as a pail bail. File a groove for the wire and point the ends into the "calks." Slip a suitable rubber tube over the wire, and fasten in place with shoemaker's thread.

Play the game according to the scoring rules of the National Horseshoe Pitching Association, which are as follows:

Only shoes that remain within 6 in. of the stake shall be scored or counted. A leaner is counted as a closest shoe and has no advantage over a shoe lying on the ground and against the stake. When each contestant has a ringer or double ringers, they are counted as equals—credited as ringers pitched but not counted to score. All plays that are equal count as ties and do not score. If all four shoes tie, such as ringers or being an equal distance from the stake, the contestant who pitched last is awarded the lead.

Score one point: for a shoe closest to the stake; for the next closest shoe when each contestant has a ringer.

Score two points: for both shoes of a contestant when closer to the stake than opponent's.

Score three points: for a ringer; for one of the two ringers of a contestant when there is one opponent ringer.

Score four points: for a ringer and a closest shoe.

Score six points: for a double ringer—the highest count a contestant can make.

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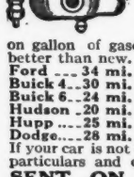

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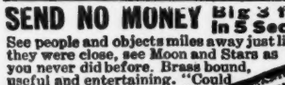

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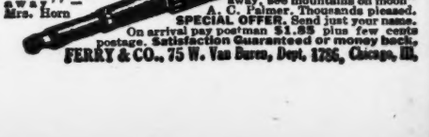

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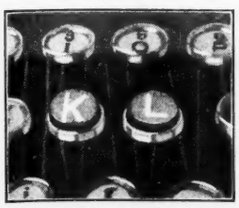
All you need to purchase is a small tube of rubber cement and a piece of soft, thick sheet rubber, costing about 25 cents. A piece of blackboard chalk and a pair of shears also will be needed.



Two of the caps in place

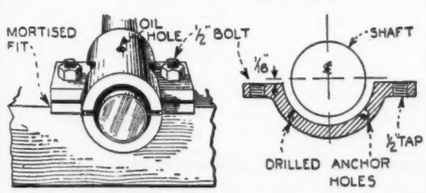
From the sheet rubber cut small disks that will just fit the tops of your typewriter keys. Then, with a hot nail or wire, melt into each its identifying letter or number, and fill the depressions with a paste of rubber cement and a little powdered chalk. Clean off any surplus paste with benzine. Allow the disks to dry in a warm but not hot place.

When perfectly dry, fasten the caps to the keys with rubber cement. They will stick well and stand hard usage, although you can remove them at any time by slipping a knife blade under them. That will leave the regular keys in as perfect condition as when they were first covered.—KENNETH B. MURRAY, Sturgis, Mich.

How to Construct Some Simple Farm Machinery Bearings

MANY a farmer and handy man hesitates to build simple labor-saving devices and light machinery because of the lack of suitable bearings. For such machines the type of bearing illustrated is one of the cheapest and best. It is of the split type, made of iron, both halves being cast over the same simple pattern. Holes are drilled in the inside for anchor points for the Babbitt metal lining and the upper cap is drilled for an oil hole.

These bearings are mortised into the sills or frame of the machine and therefore



The assembled bearing, both halves of which are alike, and a cross section showing anchorage for Babbitt metal

are rigid so far as end play is concerned. Side play is prevented by two ½-in. bolts that pass up through the wood and screw solidly into the lower half of the bearing. The holes in the cap are drilled a sliding fit over the bolts, which aline the cap perfectly with the lower half. The halves of the bearing are 1/16 in. below and above the center line to make room for the shims made of soft pine.

Three simple patterns of different sizes will handle nearly all sizes of shafts usually found on farm machinery.

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Guaranteed in this case means just what it says. There's no hokum about it, no "ifs" or "buts." Properly attach the CROWN Fuel Saver to the feed door of your heating plant and we *guarantee* you an actual saving in fuel of at least 20%—or *we will refund your money without question.* The price of coal isn't so low that you can afford to ignore this offer—particularly as the CROWN is *comparatively* inexpensive.

Many users of the CROWN obtain fuel savings up to 50%

Over 10,000 satisfied users of the CROWN are getting more heat, steadier heat and cleaner heat. They are cutting down their coal bills 1/5 to ½; eliminating smoke and deadly gases; and reducing the number of trips to fire the furnace.

The CROWN pays for itself

One user says: "*I have burned only half the amount of coal.*" Another says: "*I am saving from 40 to 50% of coal and the house is always evenly heated.*" (Names on request.)

What the CROWN is

The CROWN is a small device which may be easily bolted to the feed door of any type heating plant without injury to the door. The CROWN (see illustration) provides, by means of natural draft, an auxiliary supply of hot air *over* the surface of the fuel bed. This hot air (oxygen) burns the *rich gases* that are ordinarily lost thru the chimney in the form of "smoke." The CROWN turns this "smoke" into intense heat and assures almost *perfect* combustion.

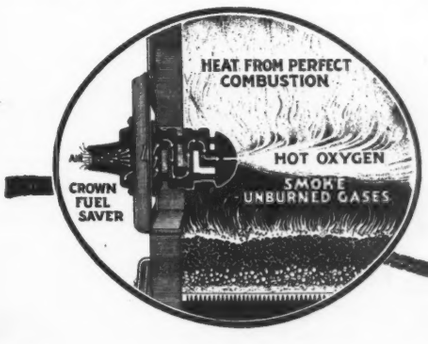
The CROWN FUEL SAVER works automatically. There's nothing to take care of; nothing to get out of order. It is easily installed without putting out your furnace fire.

Write today for details

Don't put off learning about the amazing heat-producing and *guaranteed* coal-saving powers of the CROWN Fuel Saver. Begin your coal saving now and keep every room in your home comfortably warm in any kind of weather.

Write today for details and prices and for our interesting free booklet "Making the Coal Bill Look Like 30 cents." As the CROWN comes in 4 sizes, give name and make of heating plant and approximate size of grate.

CROWN FUEL SAVER CO.
12 N. 10th St., Richmond, Ind.



Keep your home warm and save coal with the CROWN Fuel Saver

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Write for interesting profitable proposition. Every home, business house and factory a prospect.

Get Poultry Money Now!

Easy to have more eggs to sell. Prices are going up and up! Start now to double and treble egg yield by following Prof. T. E. Quisenberry's sensational methods. His Free Book Tells How.

60 Eggs More Per Hen Guaranteed!

Know how to add 100 Eggs More per hen per year. Astonishing results! Prof. Quisenberry's Book, "Dollars and Sense in the Poultry Business." Tells how to make hens shell out eggs; to save on feed; how to cull out non-layers, etc. This book is FREE. If you send 20c we will include 25 colored leg bands to mark your best layers. Mention breed of hens. Send at once.

FREE BOOK 96 Pages

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Send for my HOME-STUDY CATALOG which is a STRAIGHT-FROM-THE-SHOULDER TALK about your future in the electrical field. It contains no misleading promises such as, "EARN $10,000 A YEAR" or "BECOME AN ELECTRICAL EXPERT IN A FEW MONTHS."

DO YOU WANT A BETTER JOB?

If you are seeking to better yourself, you are far too intelligent to believe such rot. I am in business to help deserving men as I have helped thousands. I want to help you if you will permit me to do so. My instructions are right to the point. My catalog speaks volumes for any man who wants to be a success in the electrical field.

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Experts endorse my course. Electrical Hand Book and Slide Rule Course presented to everyone who answers this advertisement for prompt enrollment. If you are sincere and want to help yourself and those depending on you, write for my Catalog.

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in the Auto and Tractor Business

Read what these men are doing—here is your big chance to get "on easy street." Come to these great shops on the biggest FREE offer ever made.

Big Firms Need Trained Men

The Auto and Tractor Business is on the boom. Thousands of trained men will be needed during the next few months. I get calls every day from Garages, Battery Stations, Auto Repair, Welding Shops and other successful concerns for Rahe men. When the big fellows need high-grade men they know where to come for them. They want Rahe trained men.

"My garage and Ford Agency is a big success. I owe it to Rahe training." G. Smith, W. Alexandria, Ohio.

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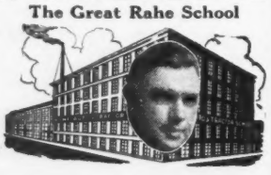
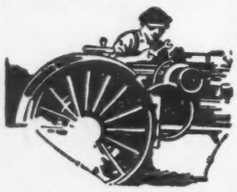
Scientific tool training—that's the secret. You do things here according to the latest engineering standards. Thousands of dollars have been spent in modern tools and equipment. That's why my men are at home with the biggest shops in the country. If you want to succeed the way Smith and Metzger and the rest have—qualify by the same method.

The Great Rahe School

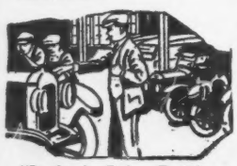


I'll Pay Your Railroad Fare and Board You!

In order to fill the openings that now exist, I am making an offer no one has ever made before—**Free Railroad Fare. Free Board.** But even that is not all. I'll tell you about the rest in my letter.



"Rahe Training was the best investment I ever made." Colby Lord, Oakland, Maine.



"I thank Rahe Training for a great job in the best garage in Lima." Howard Metzger, Lima, Ohio.

Send for FREE BOOK

My big illustrated training book tells how others are succeeding. It tells many things you ought to know about Autos and Tractors. Write for it and my short time offer NOW. It soon expires.

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RAHE AUTO & TRACTOR SCHOOL, Dept. 260, Ninth and Walnut Sts., Cincinnati, Ohio

Without any obligation, send me your big free book, "The Evolution of Transportation." Also information regarding special temporary offer.

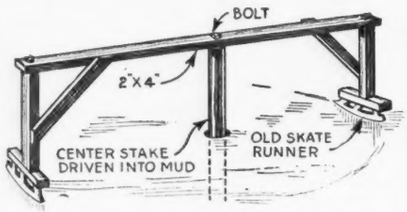
Name.....

Street.....

City.....State.....

Learning to Skate with an Ice Merry-Go-Round

TO LEARN to skate without bumps and mishaps is a simple matter if a skating wheel is constructed as shown. A post is set through a hole in the ice into the mud below and allowed to stand until it is frozen in solidly. On it is pivoted a long 2 by 4 with braced vertical legs at each end. These legs are fitted with old skates to form runners. With the bar for a support, the beginner can skate round as fast or slow as he desires.



The beginner in skating is upheld by a revolving cross arm, pivoted to a central post

Hand Stove for Skaters

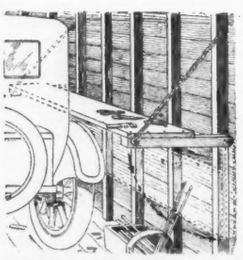
FOR skating or coasting parties, the cheaply made stove illustrated gives sufficient heat to warm chilled hands. An old bucket is needed for the top; a discarded kettle serves for the bottom. The two are riveted together, the kettle being inverted. Holes are punched about the base of the pail to promote combustion.—D. R. V.

Burns charcoal or wood

Hinged Platform for Garage

A HINGED platform fastened to the wall of the garage affords a convenient stand for washing, repairing, and refinishing the top of a closed car and is much handier than a step-ladder.

A wooden plank is fastened to two brackets, which are attached to the wall studding with bolts about 4 ft. above the floor. The platform hangs out of the way against the wall except when needed. It is then raised to a horizontal position and held with heavy chains. If no bench is available, the platform may be used for tire or other repair work.—G. L.



Platform lowered for use

CIGAR-BOX wood can be used for many purposes. How to make attractive inlaid serving trays with it will be told in next month's Home Workshop Department.

BOYS

Learn Electricity

How would you like to earn two or three dollars every evening after school and prepare yourself for a fine big job at the same time? Here's the opportunity of a lifetime for you fellows who like Electricity. Begin right now to prepare yourself for a regular man's size job in this fascinating field. Your chances for a big success are simply wonderful—the pay is big ($70 to $200 a week) and advancement comes swift and sure.

I WILL TRAIN YOU AT HOME

With my easily learned, spare time Electrical Course I will train you at home like I have trained hundreds of other boys who are now big successful men. It will not interfere with your school work and you can earn more than the small cost of the course doing odd electrical jobs in your spare time. The Course pays for itself. I will show you how to get this work and how to do it. Some of my boy students make $10 to $15 a week this way.

Look What This Boy Is Doing

"Although the School term is coming to a close, and I am pretty busy with my examinations, I manage to keep up with my electrical studies and work.

"I guess I forgot to tell you I am now in business for myself. Am doing fine, but owe it all to you. If it had not been for your Course, I, being under age, could not have secured my license in this town. But I got it, and now have all the work I can do, averaging $20 to $30 a week thru spare time work.

"I went out on a job tonight after school, on which I made $3 and brought home another on which I made $2.50 — $5.50, for 4 hours' work and no material furnished by me."

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No Deposit

Just send your name, address and finger size, and we will send you this beautiful genuine diamond, 14K solid gold ring on approval. Send no money; pay no C. O. D. Merely accept the ring and wear it a week. Then decide—either return the ring and call the deal closed, or keep it and send only $3.75 a month until our cut price of $38.75 is paid. (Regular $50.00 value.)

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Each ring is solid 14K green gold, with 18K white gold top, exquisitely hand engraved and set with a fine, large, extra brilliant, perfectly cut, blue-white genuine diamond. Order now—at once! Send name, address and finger size. Also kindly give your age and occupation and say whether you want ladies' or men's ring. Write today!

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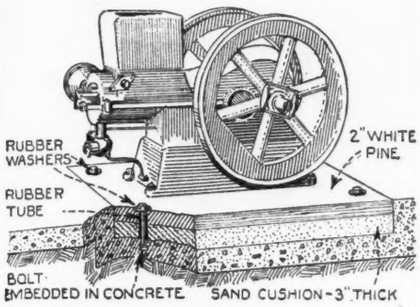
Cushion of Sand Reduces Noise of Small Stationary Engine

CUSHIONED on a layer of sand, any small gas or gasoline engine can be mounted so as to be practically free from vibration and its destructive results. The sand is placed between the wooden skid and the concrete floor as shown.

This idea has been in practical use in a small shop for more than three years and



The wooden skid rests upon a layer of sand and is held in place by rubber covered bolts

the bolts in the concrete floor hold as well as ever. It should be of particular value to the mechanic who has his shop in the cellar of his home and who wishes to work in the evenings without annoying other members of his family.

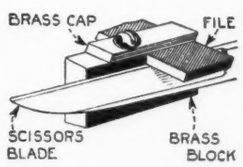
A depression in the floor is not absolutely necessary; a skirt of concrete may be built around the engine base to hold the planking and sand. This will raise the engine about 6 in. above the floor level.

Over each bolt a piece of rubber such as gas tubing may be placed, as it also helps materially in damping the vibration. —JOHN H. SCHALEK, Pittsburgh, Pa.

Simple Filing Device Keeps Your Scissors Sharp

THE filing device illustrated sharpens scissors as well as grinding them would do. What is more, any one can be reasonably sure of getting good results with it.

Snap off a short piece of a very smooth flat file, and fasten it to a small block of brass by setting the file into a groove and clamping it down with a short strip of brass and a machine screw. The important thing is to set the file at the correct angle. This is best determined by trial, using as large a pair of scissors as can be obtained to make the setting easier. When the block is set flat against the inside of the scissors blade, the file should be exactly parallel with the cutting face of the blade.

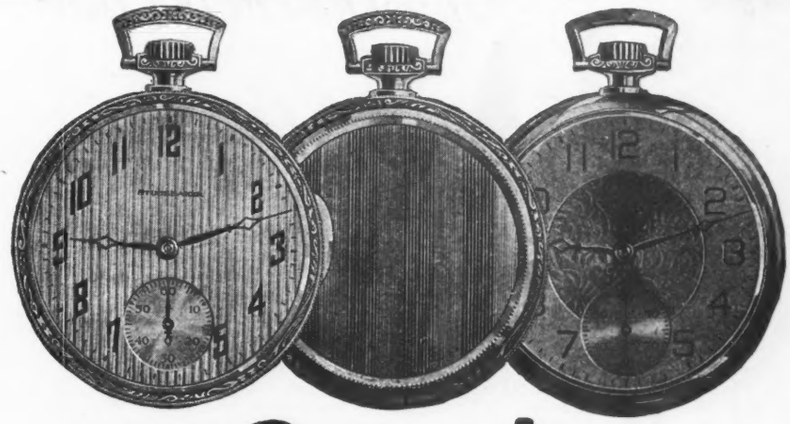


How the sharpener is used

To use the sharpener, place the block flat against the inside face of the blade and work it back and forth for the full length of the blade. Be careful to keep the block always flat on the blade.

If very dull scissors have to be sharpened, it will pay to use a somewhat coarser file for the first cut.—H. G.

"Buy a STUDEBAKER direct from the Maker"



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Just $1.00! The balance in easy monthly payments. You get the famous Studebaker, 21 Jewel Watch—Insured for a lifetime—direct from the maker at lowest prices ever named on equal quality. Send at once for FREE Book of advance Watch Styles.

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Choice of 54 latest, thin model, Art Beauty Cases in yellow gold, green gold or white gold; 8 adjustments, including heat, cold, isochronism and 5 positions. Direct to you from the factory—the greatest watch value in America today.

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Fifth Ave., New York, Custom Tailors want agents to sell advertised brand all wool tailored to measure suits and overcoats direct to wearer. Lowest prices, sell on sight. No capital or experience required. Big line, swatch samples free. Biggest commissions paid daily. Monarch Tailoring Co., 100 Fifth Ave., Dept. D-2, New York.

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Plays all records up to 12 inches. Has double main spring, playing twice as long as single-spring motors. Reproduces as loud, clear and musical as any expensive machine. Mechanism very substantial,—made to last. Case fancy polished wood. $35 Value for $20 Sold on easy terms; $1.00 down with the order, $3.00 on receipt of machine. Balance in four monthly payments of $4.00.

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- ☐ Banking and Finance
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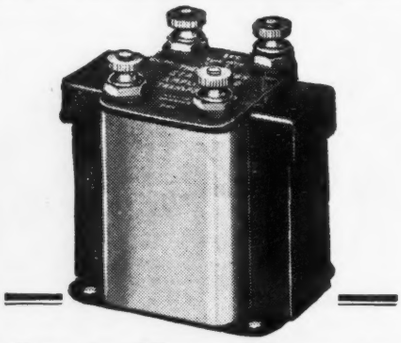

Super Transformer Audio Frequency

Does your receiving set refuse to amplify the bass notes of the piano? Does it make organ music sound like that of an accordion? If so, you are not getting the maximum enjoyment from radio.

Recent experiments in the Thordarson Laboratory have proven that the low notes of the heavy instruments can be amplified as readily as the high C of the soprano.

The Thordarson Super Transformer reaches its amplification constant at approximately 600 cycles and continues at even amplification well past the highest frequency of audiability.

Such manufacturers as the Colin B. Kennedy Co. and the Zenith Radio Corporation, convinced of the perfect reproduction of the Super Transformers, are incorporating them in all their sets.

Install a pair of Thordarson Super Transformers in your set and you will hear a radio concert as you have always wanted to hear it.

FREE BOOKLET

Write for our free Booklet No. 7, which contains many helpful suggestions regarding radio receiving.

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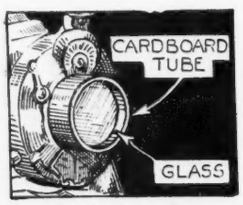
Simple Diffusing Screen Gives Artistic Photographic Effects

TO SAVE an expense of from $35 to $150 for a diffusing lens for my camera, I made a substitute at a cost of a few cents that gives artistic soft focus photographs of professional excellence.

A piece of absolutely clear, non-magnifying glass is cut the size of the camera lens and placed on a clean newspaper. A teaspoonful of common powdered resin is melted and mixed with enough powdered charcoal to give it a grayish - black color. After the mixture has cooled, it is placed in a cup or mortar and powdered as finely as possible by hammering with a pestle or rod.



Diffusing glass attached to camera

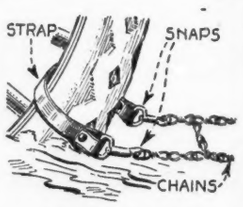
Put a little of the powder on the back of your hand and blow it over the newspaper. When sufficient resin has been blown upon the paper, the glass disk will have tiny black specks over it about .01 in. apart. Without disturbing the specks, lift the glass and heat it slightly above a candle flame just enough to start the resin melting and stick it to the glass. Clean the glass and glue it in a ½-in. ring cut from a cardboard mailing tube of suitable size. The prepared side should be toward the inside of the ring.

By placing the diffusing screen over the regular camera lens, fitting it as you would a lid on a pill box, you will be able to take soft-focus photos without any change in the time or method of exposure ordinarily used.—K. B. M.

Strap Aids when Adjusting Auto Chains in Muddy Weather

ONE of the hardest jobs a motorist encounters is putting the chains on the wheels when they are buried in a mud hole. Here is a way to do it easily:

Rivet a large harness snap to each end of a heavy leather strap about 8 in. long. When the chains are needed, slip the strap between the spokes of the wheel and connect the ends of the chain with the snaps. Stretch out the chains behind the wheel so they will wind up on the tire when the wheel begins to turn. After the chains are on, they may be fastened in the usual manner, or, if you intend removing them as soon as you pull out of the hole, just leave the loose end as it is; it will not hurt anything unless you drive fast enough to cause the loose end to whip out and strike the fender.—M. C. METZER, Silver Creek, Neb.

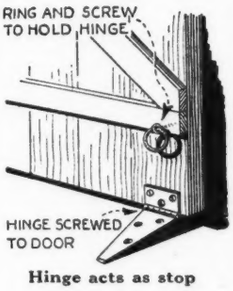


Auto chains strapped to wheel

VALUABLE suggestions for home builders will be contained in a February Home Workshop article.

Hinges Hold Garage Doors from Swinging Shut

STRAP hinges can be used at the bottom of any large doors, such as those leading into the garage, to prevent them from swinging or being blown shut. Above each hinge is a screweye and ring to hold hinge when not in use.



Hinge acts as stop

These serviceable fasteners require no special parts and can be put on in a few minutes. They are a distinct improvement over the makeshift blocks and wedges so often used.—G.L.

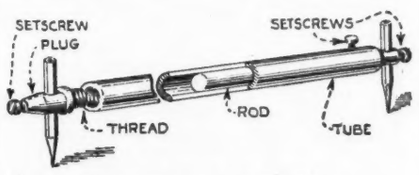
Molten Lead Provides Safe Heat for Difficult Soldering

MANY amateur mechanics, like myself, are without a blowtorch to heat their soldering iron, and need a convenient way to keep their iron hot. I have had satisfactory results by using a small pot filled with melted scrap lead. The temperature is about 600° F. and, of course, high enough to heat my soldering iron. The lead holds its heat for a long time and can be carried into the living-room for soldering the radio set, on the roof for repairing a gutter, or wherever it is not safe or convenient to have an open flame.

To melt or dissolve a soldered joint without heat, scrape a portion of the solder clean and apply mercury or quicksilver. This will dissolve the lead in the solder and release the joint. The advantage of this method is that it avoids all danger of fire and of destroying any composition or highly finished parts of a radio set with heat. Quicksilver has no bad effects, either on your hands or the set.—M. FAULKNER, Winnipeg, Canada.

Rod and Tube Form Bar of Neat Trammel

FOR drawing large circles I have found very useful the bar compass or trammel shown. A threaded plug for holding a point, pen, or pencil, is screwed into the end of a tube of suitable diameter and length. A rod slides in this tube and at

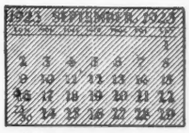


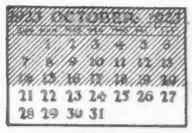
Adjustments are made by sliding the rod in and out of the tube

one end of it is a holder for the other point.

In setting the instrument, the rod and tube are telescoped or expanded the desired distance and locked by means of a setscrew.—J. H. MOORE, Toronto, Can.

C. J. Buckwalter, President, the man behind the remarkable instruction which has astonished the teaching profession and which offers wide-awake men a 50-day short-cut to big earnings.





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In New Automotive Electrical Business

The shortest road to big earnings ever known. Scarcity of experts makes positions certain and pay high. A remarkable new system of training enables you to earn $132 a week in less than two months. And we can prove it. Get my free book.

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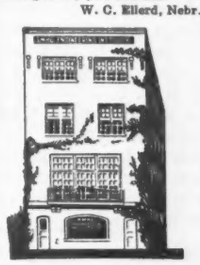

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Contestants Name Useful Tools

(Continued from page 81)

covered about 20 miles when, owing to bad roads, I twisted my hub loose from the axle. I was driving along about 15 miles an hour, when all of a sudden my car stopped dead with the engine still running. After looking about for a few minutes, I saw that the driving axle on my left rear wheel was just spinning round and round.

For a while I thought I would have to leave my car on the desert and walk the other 15 miles. Then I thought of my pipe wrench. After a few minutes' work I had tightened up well on my axle, having first removed the hub cap. I next roped the handle of the wrench to the spokes of the wheel, and this worked fine. In fact, I used the car in this way several days until a new hub could be shipped from a garage 40 miles away.

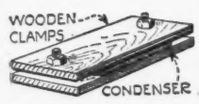
So, on the whole, I think my pipe wrench is the most useful tool I have, although I will say that all of my tools are useful.

From the large number of contributions received in this contest the judges have selected six others for honorable mention. They are the work of the following contestants:

Raymond Paul, Chicago, Ill. (Pliers)
E. J. Morrissey, West Allis, Wis. (Caliper rule)
Charles Vivier, Lankershim, Calif. (Pliers)
Charles S. Murch, Augusta, Me. (Pliers)
Frank G. Davis, Harrisonburg, Va. (Pocket knife)
Mara Snerriov, Palo Alto, Calif. (For a novelty contribution in the form of a neatly bound and illustrated booklet in verse, "The Song of the Hammer and Saw.")

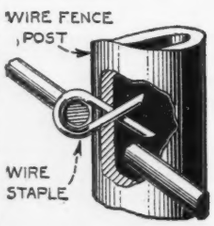
Clamping Fixed Radio Condensers to Reduce Noise and Losses

RADIO experimenters often do not realize what heavy losses take place in their fixed condensers unless they are properly made. If the plates are loosely assembled and the tinfoil insecurely held, there will be a dilating effect caused by the repulsion and attraction of the electric currents and this causes many of the howls and noises heard in receivers. Those who make their own condensers will therefore do well to mount them between two small clamping pieces of fiber or paraffined wood.



A clamped condenser

Staple Holds Wire to Iron Post



IN ADDITION to the two ways of fastening fence wires to iron posts illustrated recently in POPULAR SCIENCE MONTHLY, I have found the method illustrated is excellent. It is a saving of time and material as one hole is drilled for each wire and ordinary staples are used as fasteners. The only trick is to drill the hole smaller than the wire to be held so that the staple points have to cross when driven in.—E. C. F.

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Racing Skate Sail Provides Thrills and Is Fine Sport

By Howard Greene

ONE of the finest and most exhilarating of winter sports is skate-sailing. Nothing surpasses it in the sensation of pure speed. The skate-sail and the skater together form a miniature ice-yacht, capable of beating to windward and doing whatever an ice-yacht can do.

This particular sail is designed to "fit" a man or boy having a height of about 5 ft. 8 in. The sail itself is of heavy unbleached cotton. As the long upper spar, or sprit, will bend somewhat when in a wind, the head of the sail should be cut with a slight curve beginning about 6 ft. from the peak.

The spreader, which holds the spars apart, and the short bar reaching from

With the wind quartering, the skater can often travel faster than the wind

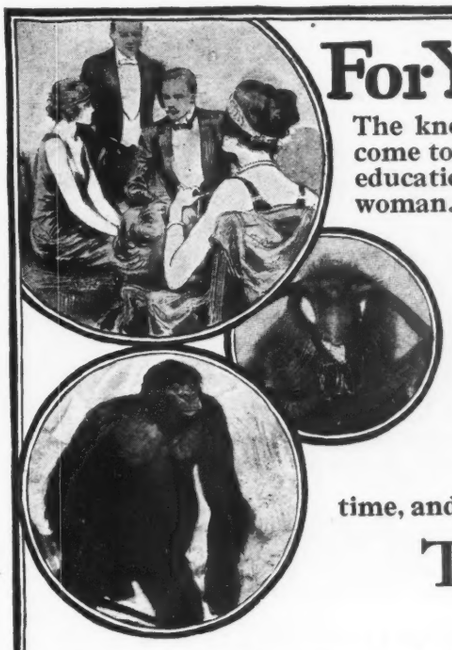
the spreader to the sprit, are made in duplicate, a set on each side of the sail. The short bar rests on the shoulder, and this should bring the boom at the level of the ankles. Bear this in mind in assembling the sail.

Make spreaders and shoulder bars of spruce 1½ in. wide and ¾ in. thick. The spreaders are to be planed to a half-round section, the flats next to the sail, while the shoulder bars are rounded to an oval section.

The spars are hinged at *B* and the two spreaders at *C* (page 120) with a strip of leather secured by a wrapping of fishline or other strong twine. A ¼-in. carriage bolt runs through both spreaders just far enough from the ends so that the boom can go between the bolt and the leather. Two collars, made of strips of leather wound around three or four times and held by glue and brads, are put on the boom to keep the spreaders from sliding fore or aft.

The upper ends of the spreaders, which are left somewhat long to allow for the stretching of the sail, are drilled with several holes to take a similar bolt as at *A*. Each shoulder bar is pivoted to its spreader by means of a short ¼-in. bolt

(*Continued on page 120*)



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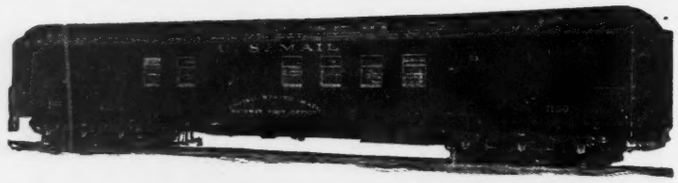

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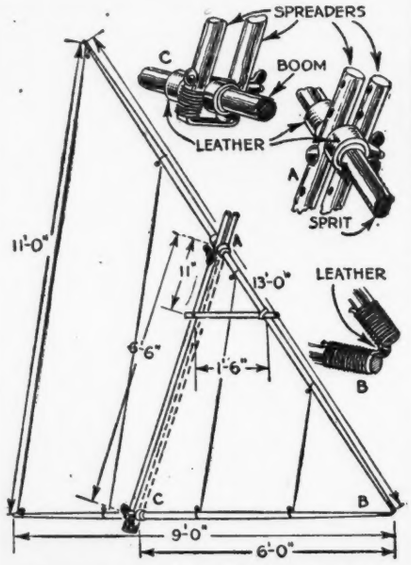
Skate-Sail Provides Thrills

(*Continued from page 119*)

or a rivet. If a bolt is used, trim down the end projecting through the nut and file off all sharp corners, to protect the sail. The sprit ends of the shoulder bars may be held in place by a strap, such as a skate strap, passing around both bars and the sprit.

In using the sail, the first important thing is the balance—the pressure of the wind should be just a trifle greater behind the sailor than before. This balance can be adjusted nicely by shifting the shoulder bar forward or aft, as may be necessary, or by slightly tilting the boom, swinging the whole sail from the shoulder bar. If sailing a course that brings the wind on the right-hand side, put the sail on the right shoulder and grasp the sprit with the right hand and the spreader



Dimensions of the skate-sail and details of the joints between the boom, sprit, and spreaders

with the left, reaching back to do this. On the other tack, get on the other side of the sail and reverse, the left hand holding the sprit.

In a heavy wind be careful not to slant the sail against the wind at too sharp an angle. The natural tendency is to do so, and it may result in the sail acting as a kite and slightly lifting the body, which results in a spill. Keep the sail approximately vertical.

One more caution. Do not make the first trial with this sail in a good breeze unless there is plenty of room. The beginner is likely to slide the sail too far forward and start shooting to leeward, directly before the wind, despite the "steering gear." The remedy is to slide the sail back until the preponderance of pressure is aft. A fall on the ice, even at high speed, never does any harm, but running ashore is dangerous.

Incidentally, if the wind gets on the wrong side of the sail, so that it tends to pull away, do not hold it by the shoulder bars or spreaders, but let it go; it will simply flop on the ice. In changing tacks, run up until the sail flaps in the wind and always go around forward of the sail, stepping over the point.

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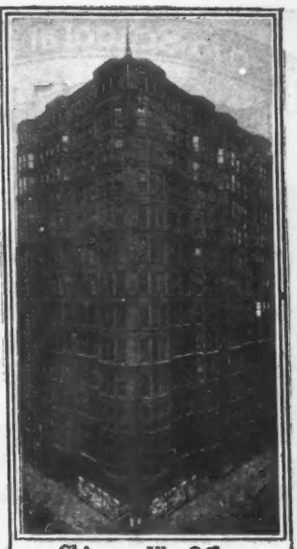

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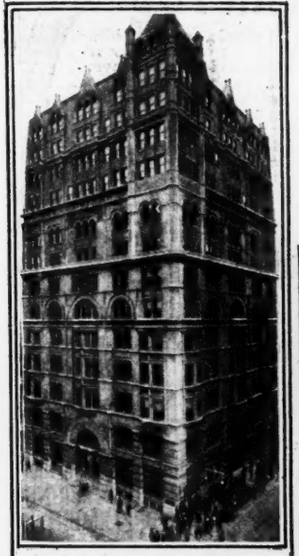

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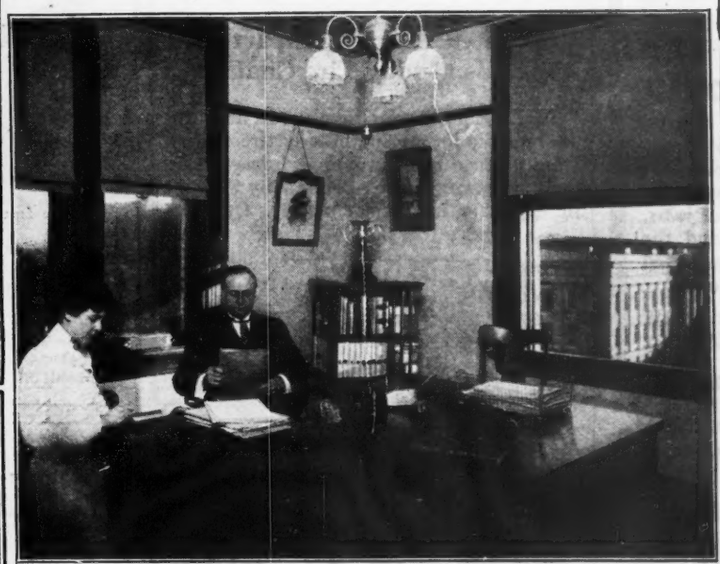

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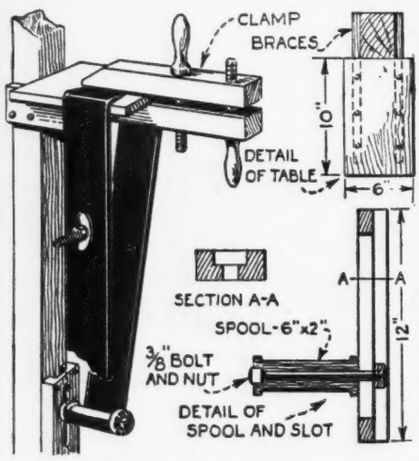
Tire-Repair Frame for Home Garage Aids in Patching Tubes

REPAIRING punctured tubes becomes a simple matter when a rack is at hand for holding them properly. Such a rack can easily be made and will save the motorist considerable time and trouble.

Nail two braces to the best lighted wall stud in the garage and fasten a small board on top of these as a table. This should be about 40 in. from the floor. A piece of



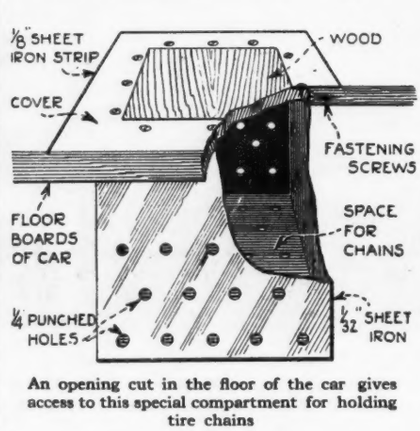
The patching of inner tubes is made easier by this table, which has an adjustable sliding spool for holding the rubber taut

wood is then slotted to accommodate a 3/8-in. bolt, counterslotted to take a 3/8-in. nut, and fastened to the stud below.

The bolt holds a large spool 6 in. long and 2 in. in diameter, over which the tube is stretched tightly as shown. The puncture patch can then be applied quickly and easily, and clamped in place.—J. R.

Ventilated Metal Compartment Holds Muddy Tire Chains

THERE is no suitable place in an automobile for storing muddy tire chains. One can readily be provided, however, by fastening a metal box about 7 by 8 by 12 in. underneath the floor boards. Quarter-



An opening cut in the floor of the car gives access to this special compartment for holding tire chains

inch holes are punched in the sides and bottom to allow free circulation of air to dry wet chains. A wooden cover with a metal edge as shown covers the top of the box, which is then hidden by the floor mat.

U.S. PATENTS

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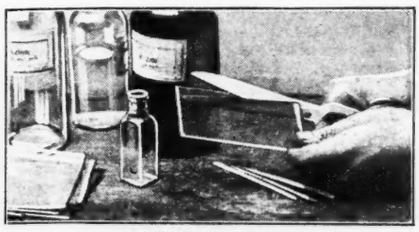
Simple Formulas that Will Save Time and Money

BRONZE, aluminum, and gold paints are finely powdered metals or alloys, which can be obtained in almost any hardware or paint store, mixed just before use with a so-called banana oil—acetone, amyl acetate, and benzol mixed in equal quantities. To give body to this "oil," a few transparent celluloid chips are dissolved in the amyl acetate



Cutting up clear sheet celluloid to make chips for thickening "banana oil"

until a thick solution is obtained. This is then diluted with the other two liquids.

RAIN spots on the ceiling can be removed with a little unslaked lime dissolved in alcohol (denatured alcohol can be used). The lime is thoroughly shaken up with the alcohol until it crumbles into a fine powder. This mixture is then brushed over the spots. When dry, the ceiling can be painted in the usual way.

Thinning wax with Venice turpentine

THE waxing of woodwork often engages the attention of the home worker. Only thoroughly dependable commercial waxes should be used and then applied thinly and vigorously polished with woolen cloth. In its simplest way a wax for wood consists of nothing more than 2 parts of pure, white beeswax and 3 parts of Venice or well ozonized or oxidized yellow turpentine. Spirits of turpentine—which is always water white—cannot be used.

A more solid wax mixture, especially adapted for floors, although it can be used for furniture, consists of a handful of beeswax, a ¾-in. cube of rosin, and a teaspoonful of Venice turpentine. These are melted together over a small flame, and from 8 to 10 teaspoonfuls of ozonized or oxidized turpentine added.

This type of wax must be left at least overnight; better still for 24 hours, before it is brushed and polished. As soon as the thin layer is hard, it is repolished with a brush. A soft woolen rag is used for obtaining a high polish in the final rubdown.—ERNEST BADE, Ph.D.

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How to Weather-Strip Your Doors and Windows

By Dale R. Van Horn

A RATTLING window or door proclaims fuel waste in winter. It is sound business economy to prevent this loss of heat by applying weather-strip or installing storm sash and doors. The latter are, of course, ideal, but when expense must be considered, weather-strip will serve the same purpose to a degree and is much less costly.

There are so many good weather-strips on the market that one cannot go far wrong. Each kind has certain advantages and disadvantages. The plain felt strips

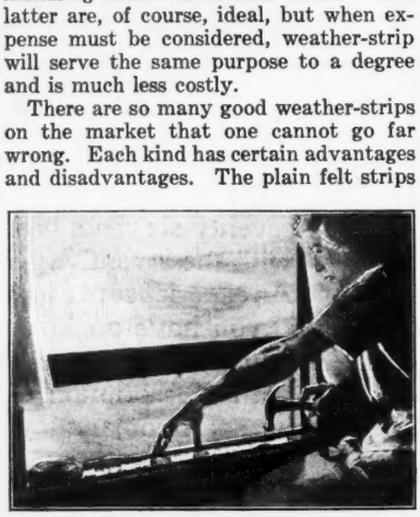

Fig. 1. Applying felt weather-strip to stop the draft through a badly fitting lower sash

(Fig. 1) are the cheapest and the easiest to put on. The ordinary wooden strips edged with rubber are almost as easily installed and have the advantage of requiring only a few small brads to hold them in place instead of a large number of tacks.

Metallic strips (usually zinc with rubber inserts) are neat and quite satisfactory if well nailed. The elastic rubber strips and cushion felt strips are somewhat similar to the plain felt, but are more substantial. More elaborate weather-strips, with interlocking members, are also obtainable, but usually require considerable work to install. For doors, however, there is a spring brass type that is inconspicuous and easy to apply.

The first step is to figure out how much weather-strip is required. To rattle the upper sash of a window when the sash catch is unlocked is the usual test for tightness. For each window that rattles, figure on obtaining enough weather-strip to go around the upper sash—probably 8 or 9 ft. Unless the window fits very badly, it is not necessary to use weather-strip on the lower sash.

Fig. 2. Nailing on a wood and rubber strip

For each outer door that is not tight, figure on enough weather-strip to go all the way around.

Suppose wooden strips have been obtained. Cut lengths to go around the upper sash of each window and nail the

(*Continued on page 125*)

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How to Weather-Strip

(*Continued from page 124*)

pieces on that part of the frame outside the sash known as the blind stop. Hold each piece firmly against the sash as you nail it, but don't press so hard that the sash will not slide.

The lower rail of the upper sash and the upper rail of the lower sash, often called meeting rails, should be drawn tightly together when the sash lock is closed. If they do not come together, take off half of the lock, plug the old screw holes and replace that half of the lock so that the lock will draw the rails together when fastened.

Fig. 3. Enlarging the striking-plate mortise

Fig. 4. Plugging the old screw holes

The lower sash can now be made tight by prying off the inside stops, which are usually about ½ by 1½ in. strips, pulling the nails through the back or cutting them off, and replacing the stops. Start nailing at the meeting rails, being sure the catch is locked, and leave between the stop and the sash a space equal to the thickness of a thin sheet of paper. This will allow the sash to slide and yet let in little air.

Only if the lower sash is very loose is it necessary to put on weather-strip, which in that case is attached on the inside stops at the sides and along the stool at the bottom (Fig. 2).

Felt strips are placed in the same way, and if necessary a piece (usually extra wide) can be tacked underneath the lower rail of the upper sash to insure tightness between the meeting rails.

Fig. 5. Applying brass strip to door jamb

Before applying the weather-strip to an outside door, see if it rattles when shut. If it does, remove the striking-plate in the door jamb, cut or chisel out a narrow sliver of wood from the slot, as illustrated in Fig. 3, plug the old screw holes with wood (Fig. 4), cut the plugs off flush, and replace the striking-plate in its new position. If this is done properly, the door will close and yet there will be no play of the catch in the

(*Continued on page 126*)

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How to Weather-Strip

(*Continued from page 125*)

striking-plate and the door will not settle.

If the door then fits fairly tightly at both sides and the top, the only weather-strip necessary will be a wide piece on the bottom of the door placed on the side most convenient for opening the door. Use 1-in. brads or 1-in. No. 6 round head screws for fastening on the strip. In addition, if necessary, fit weather-strip on both sides and the top of the door jamb on the outside so that they will press tightly against the door when it is closed and locked.

For doors that are especially bad, nail strips of ½ by 1 in. wood (or regular door stops) around the jamb, after planing the edge of each so that it will fit tightly against the door. Weather-strip can be used on top of this if it seems necessary.

An excellent weather-strip for doors is a spring brass strip that is applied right on the door jamb, as shown in Fig. 5 (page 125).

These are the basic principles to observe in applying weather-strip. They will make it easy for any home worker to weather-strip all the windows and outside doors of the home, no matter what variety of weather-strip is used.

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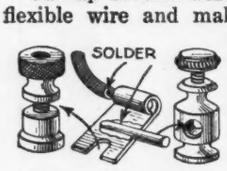

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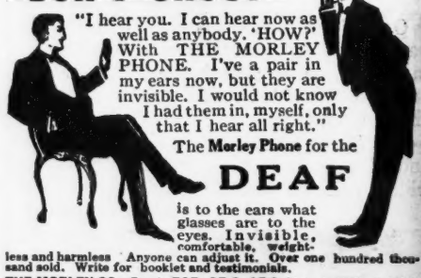

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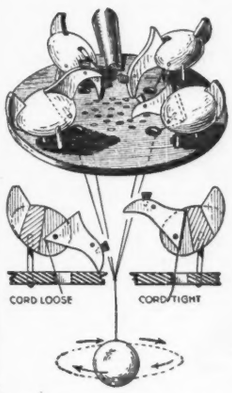
Amusing Toy Chickens Peck Grain as Pendulum Swings

IN THIS amusing toy, four chickens, mounted around the edge of a fanlike wooden platform, move their heads up and down realistically as if pecking grain. Their movements are caused by a pendulum that is swung around in circles.

Each chicken has an egg-shaped body carved from soft wood, with two wooden pegs for legs and a head and a tail cut from thin wood. The tail is fixed, but the head is pivoted freely in a slot, as shown, and moved by a length of heavy thread or thin string. The strings from all the chickens are joined together, and tied to a longer string, which has a wooden ball or other weight at the end.

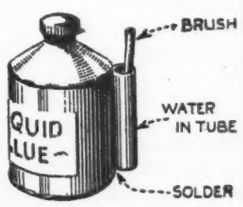


The chickens' heads bob up and down

The whole toy is painted in gay colors, and grains of corn are painted on the center of the platform, or real grains are glued in place there.—JOHN F. JOB, New York.

Keeping the Glue Brush Soft

THE best way to apply glue to small work is with a little brush, such as a mucilage brush. The trouble with this method usually is that after the brush has been used the first time, it is allowed to dry and harden. After that it is no better than a piece of wood.



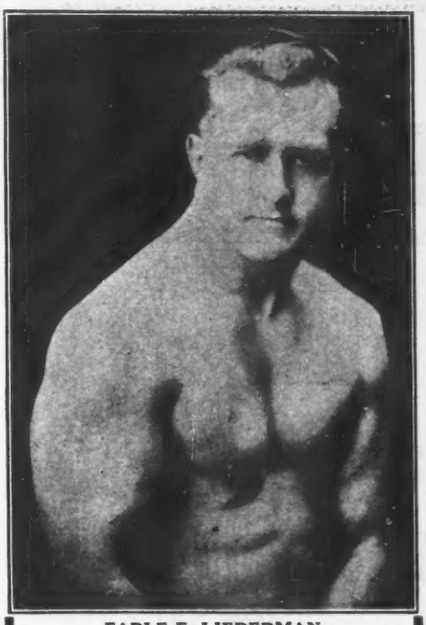
The brush holder is soldered to the can

The hardening of the brush can be prevented by making a brush-holder from a short length of brass tube, with one end plugged. It is soldered to the side of the tin glue can. Water is then placed in it, and the brush dropped in when not in use. In this container the brush will keep soft and always be at hand.

It pays to buy the larger sizes of cans of glue, and ordinarily such a can will last so long that the trouble of soldering on the tube is well worth while.

Bumper for Home Garage

A SIMPLE bumper for the rear wall of a home garage can be made by mounting a heavy plank on two old auto springs. A spring for this purpose may be obtained from a junk dealer and cut in half, one piece being bolted to the wall to support each end of the bumper. The plank can be padded with pieces cut from an old tire, or the edges simply rounded.



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I CHALLENGE THE WORLD

If a man stood on the house-tops and shouted to the people that he was the strongest man on earth, it would avail him nothing. Someone would make him come down and prove it. But records speak for themselves. I will gladly show anyone personal letters from the leading strong men in the world today that my course is absolutely the best and the quickest to acquire physical perfection. Come on then and make me prove it—I like it. I have the means of making you a perfect physical specimen of manhood, of making you a successful leader of men. You will be a credit to your community. I have done this for thousands of others. What I have done for them I will do for you. I don't care what your present condition is. The weaker you are, the more noticeable the results. Come on then, start the New Year right.

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The Shipshape Home
How to Do the Odd Jobs

Using Hacksaws

FOR general use around the house, it is advisable to select hacksaw blades with 14 teeth an inch. Fine tooth blades are apt to break on thick metals because the teeth clog up.

To obtain the best results, saw blades should be chosen for the material that is to be cut, and it will pay the home worker to keep on hand, beside 14-teeth blades, a blade or two of 24 teeth to the inch for sheet metal and tubing.

So far as the frame is concerned, it is well to get one that is adjustable to blades of different lengths, and by all means a heavy frame. If it is inclined to bend in

use, the blade will buckle and break. The newer type of pistol-grip saw frame is especially good when heavy cutting and considerable work are to be done. The advantage of an adjustable handle is that the blade can be turned at right angles to the frame when cutting off long strips of metal.

To cut sheet metal, use the saw at an angle of about 45 degrees to the work. There is then more surface to bear on and less danger of breaking out the teeth. Bear down only on the forward or cutting stroke and not too hard. On the return stroke, ease up until there is practically no pressure. The teeth will then not become dull so rapidly.

By putting two or three blades in the frame alongside each other, a wide slot can be sawn.—HENRY S. LARABY.

Tricks in Varnishing

TO APPLY varnish without laps, runs, or streaks is not difficult if no attempt is made to cover a large surface at one time. Take advantage of the panels, board divisions, and other breaks to divide the varnishing into sections.

Brush the varnish on the surface freely and quickly with the grain of the wood, then spread it in a thin film by "laying off" the surface across the grain without refilling the brush, and finally remove any superfluous varnish and smooth out the surface with a few strokes made with the

(*Continued on page 129*)

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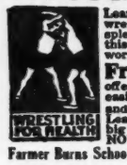

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Farmer Burns School of Wrestling, 1781 Range Bldg., Omaha, Neb.

The Shipshape Home

(*Continued from page 128*)

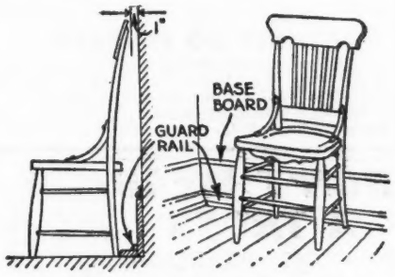
grain, keeping the brush fairly dry by wiping it on the varnish cup.

Sandpaper each coat except the last with 00 paper rubbed with the grain just enough to remove the gloss. For a dull rubbed finish, rub the final coat with pumice-stone powder and oil on a piece of rubbing felt or a cloth pad, giving each part of the surface about six or eight strokes. For a highly polished finish, rub with pumice-stone powder and water and, a day or so later, with powdered rottenstone and water.

Chair Guard Rail

THE backs of chairs often project backward farther than the legs. This results in the wallpaper and plaster being damaged whenever any one accidentally shoves a chair against the wall. In order to prevent this disfiguring of the walls, I installed in all the rooms of my house a guard rail made as follows:

Place the chair-back about 1 in. from the wall and find the distance on the floor from the back legs to the baseboard. Then rip from a ⅞-in. board a strip as wide as this distance and as long as the wall or partition. The edge to the front



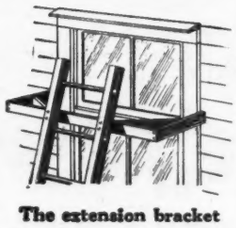
A wooden strip nailed to the floor around the baseboard serves as a chair rail

may be rounded or left square and the piece can be nailed or screwed to the floor.

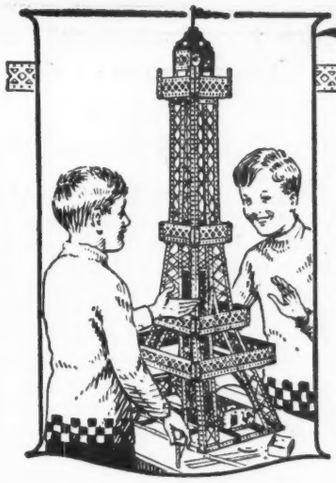
The quarter-round molding usually used in the corner between the baseboard and the floor, which, of course, has to be taken up, can be replaced in the angle between the baseboard and the guard strip. Finish to match the rest of the trim.—HARRY W. LEUTNER, Baltimore.

Painting Ladder

ANYONE who does his own house painting knows how unhandy a ladder is when used near windows or for work nearly out of reach. A simple extension bracket for the top of the ladder built as shown is a great aid in such cases. It gives unusual freedom to the painter at the top of the ladder, since there are no rungs or uprights in his way and he can stand far enough from the wall to wield a brush effectively. The extension should be at least 4 ft. wide and bolted to the ladder.



The extension bracket



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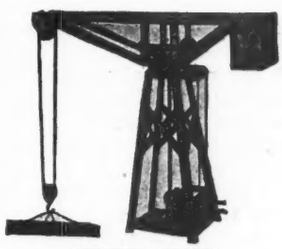
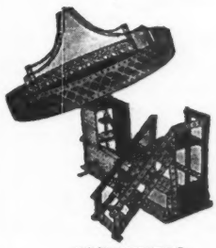
"WHERE'S that Crane you built yesterday?" asks the Meccano Boy's friend.

"Oh, that's a Tower today," he replies, "It sounds peculiar but it's quite true, for I build a new model every day with Meccano. I use the same steel strips and girders, brass wheels and nuts and bolts to build this model of the Eiffel Tower. There's wonderful fun in Meccano. You can build whatever you choose and there's heaps of fun making your models work and then taking them to pieces to build something else.

"It's because all the parts are real engineering units that I can build anything an engineer builds. And it's ever so simple—I only use this screwdriver."



GIRDER CRANE



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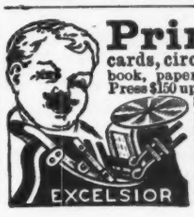

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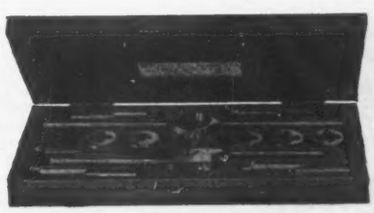

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Take the Brakes off Your Brain

(*Continued from page 32*)

others, that you must work in order to live.

That the mind cannot spin out thought of itself, that it will act only in response to some external impetus, undoubtedly is the most significant fact shown by psychology in its practical application to the every-day man, and an understanding of this fact furnishes the key that will unlock the storehouse of the hidden powers of the mind.

We do nothing—we do not even perform the workaday actions necessary to keep the breath of life in our bodies, except in response to some external stimulus—the press of necessity, the orders of our employers, something of that sort. Nature has recognized this inertia of humankind and has supplied us at birth with the means of performing, without the direction of the brain, the elementary actions necessary to living. Thus we breathe, swallow, and digest our food, send the blood coursing through our bodies, by what is known as reflex action—actions that are accomplished without interchange of messages between nerve centers, motor centers, and muscles.

Don't Wait for Necessity's Prodding

This is what governs most of the actions of the chimpanzee; why he can't progress. But far too many of us go through life virtually letting our reflexes take care of us. We act only in response to the stimulus of necessity. We never *seek* a stimulus that will stir our minds into action, carrying us on to the heights of achievement where stand those whose success we envy and, excusing our own lethargy and laziness, attribute to luck.

A few weeks ago I called at the office of a lawyer and found him in a most unhappy frame of mind. On his desk lay a great sheaf of unanswered correspondence.

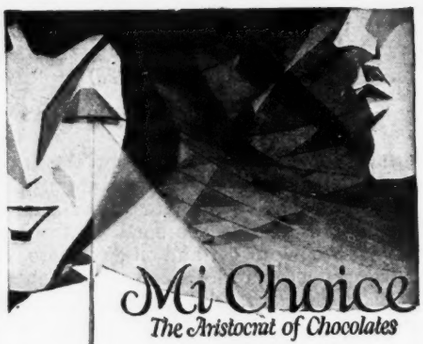
"I hate to write letters," he told me. "These have been accumulating for a week, and I've been putting off replying to them from day to day until now there are enough of them to overwhelm me. What am I to do?"

This lawyer is a really eminent man, and his distress about what seemed to me to be a comparatively trivial matter quite amused me.

Getting an Unpleasant Job Done

"I don't know what you can do," I informed him, "except to buckle down and answer the letters. All of us have mental inhibitions; yours apparently take the form of a distaste for letter writing. This distaste places a brake on your brain when you approach that task. The task itself is not difficult, but you raise up difficulties—imaginary difficulties that become real—by brooding too much over your dislike for dictating letters. Undoubtedly you do really difficult and important work without trouble, because you concentrate on the

(*Continued on page 131*)



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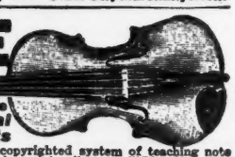

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AMERICAN TOP AND BODY CO., Lee St., Delphi, Ind

Take the Brakes off Your Brain

(*Continued from page 130*)

work itself, raising up no imaginary difficulties, but rather using your faculties to remove the actual difficulties that the work contains.

"Try this," I suggested. "Classify your correspondence according to its importance. Begin by replying to the routine letters that require only routine answers. Then, by the time you reach the letters on which you must exert real thought, you probably will have acquired sufficient momentum to carry you through."

He told me later that he had taken my advice. He found that the method I had suggested of "cranking up" his mind had banished the trouble his correspondence had given him previously.

Why Amateurs Were Successful

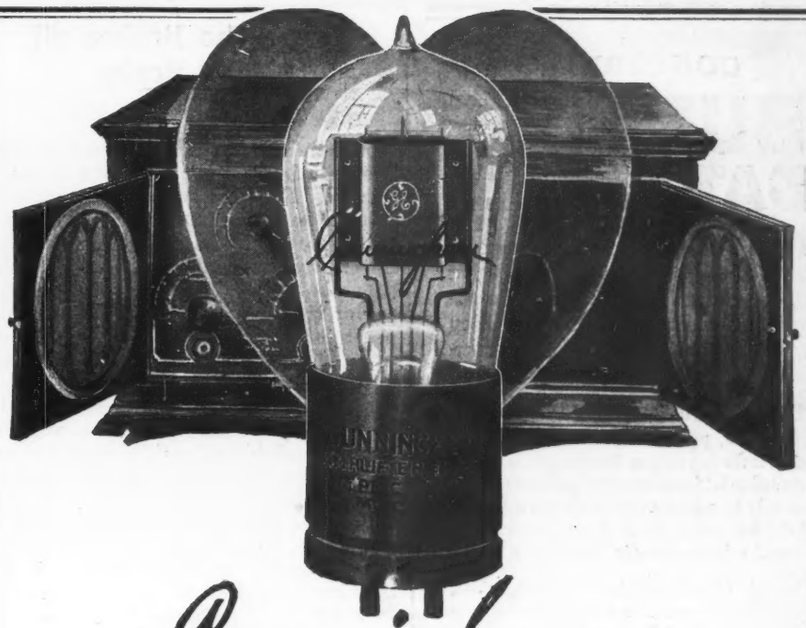
During the war, in the munition works at Watervliet, N. Y., I saw many young women of no previous training and of little mechanical skill performing the most intricate operations connected with the manufacture of firearms—work always before done by experts after years of experience. That these girls, called from homes, stores, offices, and factories to aid in supplying the sudden need for huge quantities of arms, were able to perform this intricate work satisfactorily was due entirely to the fact that they had not been informed that the tasks at which they were set were difficult. Had they been told that the work they were doing usually required years of practice, they would have become doubtful of their ability to perform it, and probably would have failed. As it was, they just took it as a routine task, and went ahead and did it.

Psychological tests conducted by the army and navy showed indubitably that the average mental age of the officers selected from civil life during America's part in the World War was about 18 years. Certainly one would say that boys of 18 would not be fit to command troops in time of war. Yet under the leadership of these same officers the American forces carried on their share of the war with conspicuous success. Why? Because under the stress of war and the sudden responsibilities it brought them, these officers of 18 mental years quickly learned to use the mental powers that had been lying dormant while they had been carrying on the easy, even affairs of civil life. In other words, their brains received the necessary impetus from without. And they rose to their opportunities through the use of their brains, completing with success the most difficult job they ever had essayed.

Napoleon's Pride His Impetus

The French Revolution gave Napoleon his chance. Napoleon was a very small man. Indeed, people used to laugh at him because of his size, and, because he was sensitive, it hurt very much. In-

(*Continued on page 132*)



Cunningham

RADIO TUBES

The Heart of your Receiving Set

IN the case of all living things the heart is the most vital organ. Weaken, injure or destroy the heart and life is accordingly weakened, endangered or destroyed.

In a radio receiving set the tube is analogous to the heart. Remove it entirely and the set will cease to function. Use an inferior tube and the results will be inefficient and generally not pleasing to listen to.

In living things a perfect heart does not always insure a healthy body, but on the other hand it is indispensable. The same is true of the radio receiving set. It may be perfect in every detail but unless the best tubes are used the results will not be perfect.

Cunningham Radio Tubes were developed in the great Research Laboratories of the General Electric Co., and are now being made in that company's modern and mammoth factories under the supervision of highly skilled engineers.

Better tubes are not attainable. There is a model specially adapted to every set, every circuit and every socket used today. Every radio dealer can supply you with Cunningham tubes. Buy them for replacements. Insist that they be included when purchasing a new set—and you will know that your receiving set has a perfect heart.

The care and operation of each model of Receiving Tube is fully explained in our new 40-page "Radio Tube Data Book." Copies may be obtained by sending ten cents to our San Francisco office.

CUNNINGHAM RADIO TUBES

C-301A—6 Volts ¼ amp. Amplifier	$6.50
C-299—3 Volts .06 amp. Dry Battery Det. & Amp.	6.50
C-300—6 Volts Gas Content Detector	5.00
C-11—1.1 Volts .25 amp. Dry Battery Det. and Amp. Special Base	6.50
C-12—Similar to C-11 with standard base	6.50

E. T. Cunningham Inc.

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Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08, and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

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With National Distribution

Wants More Local Representatives

THE man we want is now employed, but finds it difficult to make both ends meet. He feels certain that there must be some way whereby he can better his condition. He may not be a salesman but he can talk convincingly on something he firmly believes in. He may not have much money but he is not broke.

The man we are looking for is mechanically inclined and willing to devote his spare time as a local manufacturer and representative for us—work that can be done at home which will pay a splendid profit and surely develop into a business which will justify giving it all his time.

The OZARKA PLAN will give such a man more money, more independence and a real opportunity to build up a permanent, profitable business of his own. It is fully described in a large illustrated book—a FREE copy is yours for the asking.

Unlike any book you ever read, the OZARKA PLAN is a true story of life, of men, of why they fail and how they succeed. It is founded on the principle that the world owes every man a good living, a home of his own and a surplus for a rainy day. This book proves the reason why some men are millionaires and why others, by the sweat of their brow made them so.

In territory not now covered the right man is wanted—the OZARKA PLAN may be the turning point in your life, so in writing for the OZARKA PLAN Book, tell us about yourself fully and give name of your county.

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Of interest, perhaps, to the thinking battery buyer is the fact that no Burgess product is advertised or sold until its merit has been proven, not only by our own rigid tests, but also those of the foremost radio engineers, manufacturers and experimenters in the country.

Through friendly criticism and suggestions, together with extensive research and engineering by the C. F. Burgess Laboratories the efficiency of Burgess Batteries has increased to a degree which we believe is not equalled elsewhere.

Ask Any Radio Engineer

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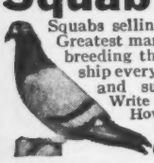

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Custom tailor made to fit all makes and models of cars. Any person who can drive a car can put it on. Roof and quarters sewed together, with rear curtain, fasteners, welts and tacks complete. Give name, year and model number of your car, and we will send you catalog with samples.

Liberty Top & Tire Co., Dept. E-8, Cincinnati, O.

Take the Brakes off Your Brain

(*Continued from page 131*)

stead, though, of bending humbly under the ridicule of his fellows, he was roused intensely by it. When opportunity came to him he gave the lie to the historians who were fond of saying that the world never again could produce another general as great as Caesar or Alexander.

Nor is it necessary for a war or some other great emergency to arise to cause us to make use of the full powers of our minds. An American novelist whom some critics call our greatest spent his boyhood in luxury. There was no necessity of his using his mind for any other purpose than devising ways to enjoy himself. At the death of his father, he inherited a large sum of money, and went to Europe, when he gave himself over to the expensive amusements which the Continent provides for the wealthy idler. In a couple of years he had wasted his fortune and faced the necessity of working or starving. In desperation he turned to his pen, and after a period of discouragement succeeded in catching the public fancy and winning both fame and wealth from his writings. In his case the necessity for supporting himself supplied the impetus which his mind required to stir it to action. Had the necessity not arisen, this man probably would have wasted his life.

Poverty as a Brain Stimulus

A famous financier of other days used to say that the best thing that could happen to a young man was that he should go in debt for some legitimate purpose. Similarly, a well-known jurist frequently expressed the opinion that the best environment in which a growing boy could be reared was one that placed him under the necessity of supporting a widowed mother. Both of these men were speaking from their own experience. To one the discharge of a debt that he contracted to launch his first business enterprise was the spur that drove him to make full use of his mind. To the other it was the necessity of supporting his mother.

A large percentage of the successful men of this age were the sons of struggling country pastors. This is not surprising. Early in life these men received the stern impetus of necessity, which taught them to use all the powers of their minds. The habits of mind they acquired as boys remained with them through life, leading them to greater and greater achievements.

Adversity Is a Great Teacher

Most of us fear adversity. Yet adversity well may be considered a blessing in disguise, since to most of us it will prove the impetus we need to start our minds working to their full capacity.

Francois Coppée, the distinguished French writer, in one of his books, tells the story of a banker who failed, and in doing so ruined a half-dozen persons who had intrusted their money to him. Flee-

(*Continued on page 133*)

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PLAY ALL THE LATEST HITS

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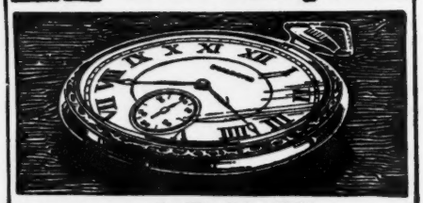
FREE A Beautiful Hawaiian Guitar

21 Jewel Burlington



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You Can See Them Fire

Just lift the hood and look. See instantly which cylinders are "dead." No guessing. No testing. Cost no more than ordinary plugs. Save 5re. Extra durable. Sold only by "Paul Men". Agents smashing all earning records. Exclusive territory. Write quick.

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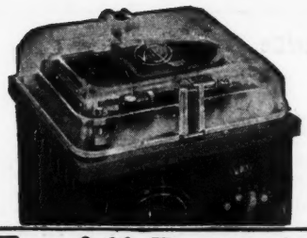

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Plugs into regular electric light sockets. Takes about a dime's worth of current for an average charge.

A lot of people were dissappointed last year because we could not make enough Valley Chargers. We are making more this year, but with the improvements, they will be in greater demand. Don't miss out. At all good radio dealers.

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ACE TYPE V $20.00

Armstrong Regenerative Receiver

Licensed under Armstrong U. S. Patent No. 1,113,149

The low cost of this set together with its efficiency and simplicity makes the great demand for it increase daily. A long range receiver. Stations from coast to coast heard distinctly. An ace two-step amplifier in connection with this set at $20.00 makes use of loud speaker practical. Has Crosley Multistat which permits use of any make tube. Ask for "Simplicity of Radio"—it's FREE. Dealers, write on your letterhead for splendid sales proposition.

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Write today for this Booklet.

CROSLEY MANUFACTURING CO.

117 Alfred St. Cincinnati, O.

Take the Brakes off Your Brain

(*Continued from page 132*)

ing the country, he went to Canada, where in time he recouped his fortunes. Then it occurred to him that he should return to his native land to repair the harm he had done those who had suffered through his reverses. What was his surprise to find all of them far better off than they had been in the days before his failure. Adversity, the press of necessity, had supplied them with the mental impetus they needed to carry them on to success through their own efforts.

This is a purely fictional story, but it is founded on a premise which psychology shows to be entirely true. Adversity, crises, sudden responsibility, almost invariably drive men to achievements beyond any they have dreamed. We see evidence of this about us constantly. The young man who starts a business enterprise on small capital will learn to work harder, to use his mind more than will a salaried employee, and his efforts will carry him on to success.

Find Your Own Brain Stimuli

A man suddenly advanced to a position of greater responsibility in the business world will rise to his new responsibilities, evidencing capacity for work and mental effort such as his fellows had not suspected he possessed. New business, the more responsible job, the sudden necessity for supporting a family supplies the impetus that the mind requires.

Too many of us, lacking such responsibilities, crises, or the spur of necessity, potter through life, using our minds no more than we have to, satisfied as long as we are supplied with the bare necessities of existence. Through psychology we learn that the mind will not work except in response to an impetus from without; yet how many of us, if that impetus is not supplied by circumstances, try to supply it ourselves? That we can supply it, psychology also shows. We learn that while the mind, like the automobile, requires a crank to start it, yet once started, we can through our will guide it along whatever paths of thought we wish.

Envy or Emulation?

An order from your employer will start the engine of your mind working. Yet the direction in which your mind will travel after receiving that order rests entirely with you. You may grumble at the extra work you have been asked to do. You may even, if you wish, flatly refuse to do it. Or you may—and you probably will, if you are wise—accept the order cheerfully and throttle your mental engine up to full speed to accomplish the task to the best of your ability. Likewise, the success of another will stimulate your mind into activity, but it rests with you whether that activity will take the form of envy and jealousy of him and complaint at your own lesser fortune, or the desire to emulate him and achieve success similar to his.

(*Continued on page 134*)

The Opinion of 1,000 Others

To find out what influences ambitious men and women to enroll with the American School, an advertising agency sent out a questionnaire to one thousand names, taken at random from our student rolls. The answers to three of these questions show very clearly how our School is regarded by our students, both before and after enrolling.

Why Students Inquired About Our Courses

31.5% wrote only to the American School, because our advertisements impressed them more favorably than the advertisements of other home study schools.
27.0% had heard of the American School before.
23.7% answered several home study school advertisements, so they could select the best.
15.1% were recommended to our school by a friend or acquaintance who had taken one of our courses.
2.7% inquired for various other reasons.

Why Students Considered Taking a Course With Us

37.4% wanted to qualify for better positions.
22.5% wanted assistance in their present work.
20.7% wanted more information on the subject for which they enrolled.
11.2% wanted to prepare for college entrance examinations.
7.4% wanted to "brush up" on subjects previously studied.
.8% enrolled for various other purposes.

What Students Really Think About Our Courses

97.2% say our courses are "Good."
1.4% say our courses are only "Fair."
1.4% say our courses are "Not what they expected."

When you take the average opinion of 1,000 people, selected at random, about some one thing, you will get a definite idea as to the worth of the thing. The average opinion of these 1,000 people is that our courses are O. K. Do you need further proof? If you want to get ahead and are considering a course of practical training, you will find that the American School is the best place to get that training. From us you will get the best grade of training at the lowest cost. And further—

Our Money-Back Guarantee Protects You

You cannot lose when you enroll with us. If after you have finished your course you are not absolutely satisfied, if you do not believe that the training we gave you will help you to get ahead, just write us and we will refund to you every cent you paid us. Mark the coupon. Your request for information puts you under no obligation and no AGENTS WILL BOTHER YOU.

American School

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American School

The American School is not a money-making corporation, but like resident schools and colleges, is chartered strictly as an "Educational Institution, not for profit."

More than 200 famous engineers and educators prepared the special instruction papers for our students.

For over a quarter of a century, Big Engineers, Educators and Business Men have recommended the American School. They know that our long experience as an educational institution guarantees better training at less cost than can be given by any school conducted for profit.

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Gentlemen: Please send me full information on the subject checked. It is understood that this request places me under no obligation and that no agents will bother me.

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..Automobile Repairman	..Mechanical Engineer
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..Business Manager	..Steam Engineer
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..Sales Manager	..Sanitary Engineer
..Cert. Pub. Accountant	..Surveyor (& Mapping)
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..Draftsman & Designer	..High School
..Electrical Engineer	..Fire Insurance Expert
..General Education	..Wireless-Radio
..Personal Analysis	..Business Law
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Name.....

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He took the world to her

Twenty-five years ago a boy left a little country town to find his fortune. He found it.

Two years ago, when radio was still a novelty, he took a receiving set back to the old home and set it up in his mother's room. That evening the world spoke to her.

She could not follow her boy away from home. But the best that the world has to give—in music, in lectures, in sermons—he took back to her.

The modern vacuum tube, used in radio transmission and reception and in so many other fields, is a product of the Research Laboratories of the General Electric Company. These Laboratories are constantly working to develop and broaden the service of radio.

GENERAL ELECTRIC

Take the Brakes off Your Brain

(*Continued from page 133*)

It is a striking, but true, expression that the ordinary graduate of a high school in our time knows much more about a great many things than Aristotle, the wisest of men in his day, ever knew about them. But it was not Aristotle's knowledge that gained him his reputation as the greatest of thinkers—the sovereign of men who know—it was his power to use his information to the best advantage in thinking out the problems that lay all around him.

How the old Greek philosopher, who was deeply interested in psychology, would have envied us our knowledge of the make-up of the nervous system and of its mode of action as far as that has gone!

And yet we, to whom this knowledge is readily available, make scant use of it, plodding along in the old-fashioned way, letting our instincts and the practice of whatever talents that are forced on us carry us through life.

What is it that has put a brake on your brain? Whence springs the inhibitions that are holding you back? From laziness? From ill temper? From self-satisfaction? From grumbling discontent? From lack of self-confidence?

Look within yourself for the answer, and see that you give it truthfully. Once conscious of the thing that is impeding you, you have gone a long way toward banishing it. This you can do by calling on your will. Recognizing your trouble and using your will to combat it, supplies the impetus your mind needs to start it working toward its full capacity.

It All Rests With You

And once started, its own momentum will carry it forward. Then difficult tasks will become simple and what had seemed impossible of accomplishment before will become relatively easy. It all rests with you. Once you make up your mind to do a thing you will find you have the mental equipment with which to do it. You will find that you have hidden resources of power which you never suspected and these latent powers will carry you far on the road of success and happiness.

But making up our minds emphatically enough to stir ourselves into action is something that too few of us do. Instead, we let ourselves be guided by our sensations. We are ruled by our senses, while our will power lies dormant. Were we to awaken it, we should be able to accomplish ever so much more than we can ever be tempted to do by our senses.

There lies the difference between the unsuccessful man and the successful one—in the use of the will.

How the senses operate, how they may be made to serve us in drawing on the hidden resources of our wonderful mental storehouse will be described by Doctor Walsh in the next article of this series.

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Here Are Correct Answers to Questions on page 71

1. It is probably because waste materials of various kinds accumulate in the body in such a way that they cannot be got rid of. For instance, compounds of lime get deposited in the walls of the arteries so that the walls become hard and brittle. We know very little as to why all this happens.

2. It is mainly a difference in the impurities. Hard coal is more nearly pure carbon. Both hard coal and soft coal have been formed by the slow hardening of vegetable matter buried in the rocks. The hard coal has hardened more completely. A larger percentage of its original impurities has been got rid of.

3. Light. It travels 186,326 miles a *second*—more than seven times the circumference of the earth.

4. As the earth turns from west to east, and as London is east of New York, the sun rises in London while New York is still dark.

5. The millions of little crystals of ice that are formed all through the ice cream must be kept small or the cream will not be smooth. The stirring helps to keep these crystals small.

6. This is a form of hypnotism, you yourself being both hypnotist and subject. Suppose you are climbing down a ladder out of a burning building. Your attention is fixed completely on the fire and on the progress you are making in your escape. You have no brain power left to notice anything else.

7. Remember that a glass prism will split light into the seven primary colors. A group of falling drops of water will do the same thing. If the sun shines on such a cloud of falling water drops, as in a shower of rain, the light reflected from the drops will be split up in this way and a rainbow results.

8. Only if you could get a machine that would run with absolutely no friction or other resistance. No such machine has ever been made. Even if it could be made, you would not be able to get power from it. Any attempt to do so would stop it.

9. The poorest conductor of heat is a vacuum. The only heat that will pass through it at all is the kind of heat called radiant heat, such as that received from the sun. Vacuum bottles are double, one bottle inside the other. The space between them is a vacuum.

10. Small ones have been made by dissolving carbon in melted iron and allowing it to crystallize as the melted iron cools very slowly and under pressure. No one has succeeded in making large diamonds.

11. Woolen cloth is made of many tiny fibers twisted together to make threads and then woven. When the fibers are wet, they twist up more and this makes the threads shorter.

12. Scientists believe that the animal ancestors of man were hairy all over like an ape. Man gradually is losing his hair, probably as a result of wearing clothes, so that hair on the body is no longer necessary as a protection. Clothes were invented before hats. So the head hair has not been lost as completely as the hair elsewhere.

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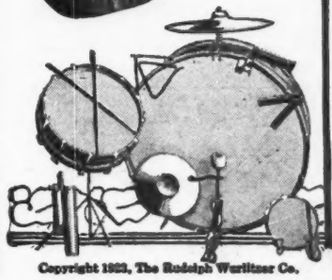

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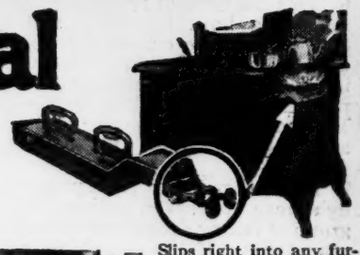

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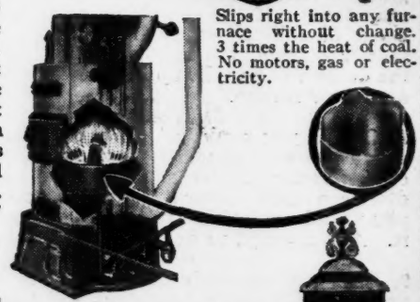

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